VEGETABLE CROP PROTECTION GUIDE

2012–2013

Publication 838

Ministry of Agriculture,
Food and Rural Affairs

Ontario

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of the Environment (MOE)

The information in this publication is general information only. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. It is against the law to use the product in any other way.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has merit and value, and the human health and environmental risks associated with its proposed use are acceptable.

1. **Full Registration**
   Pesticide registrations are normally granted for a period of five years, subject to renewal.

2. **Conditional Registration**
   Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Emergency Use Registration**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at *www.pmra-arla.gc.ca* or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MOE is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09.

All Pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at *www.e-laws.gov.on.ca* or by calling ServiceOntario Publications Toll-Free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MOE, classified products are posted on the MOE website: *www.ene.gov.on.ca*.

Certification and Licensing

Growers and Their Assistants

For information about certification for growers and training for assistants, check the Ontario Pesticide Education Program website: *www.opep.ca* or call 1-800-652-8573.

Commercial Applicators and Their Assistants

For more information about exterminator certification and licensing and technician training, check the Ontario Pesticide Training & Certification website at *www.ontariopesticide.com/OPTC/default.htm* or call 1-888-620-9999 or 519-674-1575.

Cette publication est aussi disponible en français.

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Acknowledgements

The information contained in this publication is printed following review by the Vegetable Sub-Committee under the Ontario Pest Management Services Committee.

Need technical and business information?

Contact the Agricultural Information Contact Centre at
1-877-424-1300

Or ag.info.omafra@ontario.ca

Looking for vegetable production information on the Internet?

Check the OMAFRA website at
www.ontario.ca/crops

This publication contains pesticide products that have been registered as of September 26, 2011, on vegetable crops. Any supplements to this publication will be posted on the OMAFRA website at www.ontario.ca/crops.

This publication is a companion to OMAFRA Publication 839, *Ontario Field Vegetable Guide* (expected release date: 2013). This publication will contain more comprehensive information on pest management strategies, pest life histories and diseases, and other information related to the production of field vegetables in Ontario. Publication 363, *Vegetable Production Recommendations*, will remain available to growers, at a reduced price, providing vegetable production information until Publication 839 is available.

Cover images:

Front cover small photos (left to right): onion bacterial rot, Colorado potato beetle, severe anthracnose on red bell pepper

Back cover small photos (left to right): alternaria fruit symptoms on tomatoes, adult stink bug, downy mildew on cucumber

Do you know what pesticide drift looks like or what you can do about it?

OMAFRA and CropLife Canada have created two short videos with innovative visual demonstrations using dyes and night-spraying to show what drift actually looks like. See how spray particles behave and discover what changes can be made to your spray program to greatly reduce the risk of pesticide drift.

Learn more at www.ontario.ca/spraydrift.

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Introduction

Products Listed in This Book

Products listed in this book are registered for use on field vegetable crops and have been reviewed by the registrants and the Vegetable Sub-Committee under the Ontario Pest Management Services Committee. Products are organized by pest for each vegetable crop.

Levels of Control for Fungicides and Insecticides

According to the Efficacy Guidelines for Plant Protection Products (*Pest Management Regulatory Agency Directive 2003–04*):

Level of Control	Description
Fungicides	
Control	The product, when applied in accordance with the label directions, consistently reduces disease incidence and severity to a commercially acceptable level.
Suppression	Consistent control at a level that is not optimal but still of commercial benefit. Suppression is not used for products that show highly variable performance.
Insecticides	
Control	The product, when applied in accordance with the label directions, consistently reduces pest numbers or pest damage to a commercially acceptable level.
Suppression	The product, when applied in accordance with the label directions, does not consistently reduce pest numbers or pest damage to a commercially acceptable level. Under such situations, the level of performance offered by the product must still have value in a pest management program.

Note: These guidelines are currently suggestions and are under review by the Pest Management Regulatory Agency. Current, approved Canadian labels may also include a statement "reduction in damage from" the target pest. This is an undefined level of control less than suppression, and this statement is still under review with the Pest Management Regulatory Agency.

1. Integrated Pest Management

Integrated pest management (IPM) is an approach to managing pests that uses all available strategies to reduce pest populations below an economic injury level. IPM does not advocate a continuous pesticide spray program to eradicate pests. Instead, it promotes the integration of cultural, biological and chemical control strategies. Using these pest control strategies can minimize the adverse effects of pesticides on the environment and maintain economic returns.

An IPM program makes control decisions based on:

- pest identification, biology and behaviour
- beneficial organisms
- monitoring techniques
- use and timing of appropriate management tools
- sprayer calibration
- resistance management strategies
- stage of crop growth
- recordkeeping

More detailed information on pest identification, biology, trapping, monitoring, recordkeeping and management techniques can be found in OMAFRA publications such as:

- Publication 839, *Ontario Field Vegetable Guide* (expected release: 2013)
- Publication 363, *Vegetable Crop Production Guide* (Publication 363, *Vegetable Production Recommendations*, will remain available to growers, at a reduced price, providing vegetable production information until Publication 839 is available. Any pest control guidelines contained in this publication may be out of date.)
- *Ontario CropIPM*, www.ontario.ca/cropIPM
- Publication 700, *Integrated Pest Management for Onions, Carrots and Lettuce in Ontario: A handbook for growers, scouts and consultants* (Video also available)
- Publication 12, *Sweet Corn Production Manual*

Current information is also available on the OMAFRA website at www.ontario.ca/crops. Additional information is supplied via newsletters, meetings, field monitoring, demonstrations and pest management workshops. For more information on available IPM programs, contact OMAFRA's Agricultural Contact Centre at 1-877-424-1300, or the nearest OMAFRA Resource Centre.

Monitoring

Monitoring of pest populations, weather conditions, plant health and disease symptoms is very important to IPM programs. It provides growers with the information to forecast and evaluate potential pest problems. Effective monitoring identifies the pest present, estimates its population and recognizes conditions favourable for pest development and damage. Early detection of a pest allows for more flexibility in the choice of management options. Regular monitoring will also help identify minor or secondary pest populations before they cause significant damage.

Monitoring is best done by the same person or service throughout the growing season. Information on field history, soil type, varieties, spray records and weather is important when interpreting monitoring results.

Monitoring typically includes sampling, the use of traps and visual scouting. The successful implementation of a monitoring program requires an understanding of pest biology. Good recordkeeping is an essential component of any IPM program. Complete records are important for year-to-year comparisons. Keep a site map and records of:

- status of crop health and stage of crop
- population levels of pests and beneficial organisms
- damage observed
- location of damage
- weather and other environmental conditions
- sprays and other control measures used

Scouting

One of the best ways to keep track of insects or the amount of disease present in the crop is to visually inspect the field. Scout fields at least once a week. More frequent monitoring is recommended when the pest is most active. Weed surveys taken across the field will aid in the selection of weed management strategies. Tools such as a hand lens, a trowel and/or sweep nets can improve insect and disease scouting efficiency.

When scouting the crop, inspect plants in several different areas across the field for an accurate estimate of pest pressure. Field borders and fencerows are often favoured overwintering sites for many insect pests. Scouting guidelines, available in publications such as *Ontario CropIPM* often indicate the number of plants that should be inspected during scouting operations. Inspect a minimum of 30 plants (sometimes as many as 50 to 100, depending on the crop and pest) across the field before making any pest management decisions.

Sampling Technique for Monitoring

For some vegetable crops (i.e., cole crops), a sampling method (described below) may be used to collect information on insect populations and the amount of disease present, as well as the distribution of pests in the field.

- Divide large areas into sample blocks based on cultivars and planting dates. Many vegetable crops have periods where they are more or less susceptible to attack and damage by certain pests.
- Walk in a V, W or zig-zag pattern across the block to collect samples from a representative area. The position of the collection sites should vary each time the field is monitored. Keep in mind that some pests are typically found along borders, while others may be either randomly distributed or clumped.
- Look away from the plant when you choose plants to sample, otherwise you will tend to choose damaged plants and bias the sample.

Thresholds

An IPM program uses control guidelines or thresholds to decide when to apply pesticides to prevent economic loss. Some damage to the crop is normally tolerated as long as this damage does not exceed the cost of the control.

Thresholds for direct pests, which feed on the harvested portion of the crop, are generally lower than thresholds for those that do not (indirect pests). Thresholds may vary depending on the stage of development of the crop, the stage of the insect or the product being used to manage the pest.

Disease guidelines may be based on damage potential. This is often estimated with weather models, crop tolerance, stage of crop development and field observations.

Thresholds have not been developed or validated for all pests in Ontario. Even established thresholds require adjustment for different varieties, markets and crop vigour. Established thresholds may also require revision to optimize the use of new, reduced-risk products.

Example of a threshold used in brassica crops

Flea beetles: Up to the 6-leaf stage, plants can tolerate no more than 1 flea beetle per plant. After this stage, feeding will not interfere with plant growth. Feeding damage at later stages may have an impact on marketability and crop quality.

Trapping

Certain insect pests may be monitored using traps. In vegetable crops, traps make use of pheromones, baits, visual attraction or a combination of all three. Traps provide information on pest activity and insect numbers. Trap catches can also be used to initiate and validate degree-day models (described below), which predict the occurrence of key life stages and provide information to optimize spray timing. Most traps catch only the adult stage of the insect and may not provide information on the destructive larval stage.

Pheromone traps

Pheromone traps use a female sex pheromone lure and some form of trap (sticky, bucket, Hartstack or other) to attract and capture adult males. The synthetic lure is meant to be specific to each insect species, although closely related species are sometimes attracted to commercial lures. Pheromone traps are useful for indicating the presence or absence and the relative abundance of insects. Insecticide application timings for several pests of brassica crops and corn are based on the number of insects caught in pheromone traps per week or day, depending on the crop.

Visual traps

Colour is an important visual stimulus for insects. Yellow, white, orange and blue sticky boards are attractive to certain vegetable pests, especially flies and thrips. These traps can indicate the presence and relative abundance of a pest, and can be used to track the movement of a pest into a field.

How to use traps

- Place traps in the field 1–2 weeks before the expected emergence of the insect. Follow pest-specific guidelines concerning the number and location of traps for the crop.
- Clear foliage away from the trap.
- Trap placement, such as position in the field, is pest-specific and is critical for accurate monitoring.
- Use separate traps for each species and label traps clearly.
- Pheromone lures are pest-specific. They are very sensitive to contamination from other types of pheromones. When using several types of pheromones at once, wear disposable gloves to prevent cross-contamination and maintain a minimum of 40 m between traps, or the distance recommended by the manufacturer.
- Use flagging tape or coloured stakes to mark the location of traps.
- Check traps twice weekly and record the number of pests caught. Remove the insects at each visit.
- Traps require maintenance. Replace the trap when it becomes too dirty or is no longer sticky. When replacing traps, transfer the old lure into the new trap or replace it if required.
- Pheromone lures generally have a 3–6-week life span but this varies by product and weather conditions. Some lures are effective for only 1–2 weeks. Extreme heat may affect the longevity of lures in the field. Replace the lures according to the manufacturer's instructions. Store unopened, unused pheromone lures in a refrigerator or freezer, or as directed by the manufacturer.

Degree-Day Modelling and Determining a Biofix

Temperature, light and moisture affect the growth and development of plants and pests. Of these, temperature is the most important factor for insect and mite development. These pests need a certain amount of heat to move to the next development stage.

The amount of heat required for insect and mite development remains constant from year to year, but depending on weather conditions, the amount of actual time that it takes to complete development (generation time) can vary. Insects and mites have a minimum and maximum base temperature below or above which development does not occur. These base temperatures are different for each organism.

Growing Degree-Days (GDD) are used to estimate the growth and development of pests in the growing season. Events such as egg-laying, percent egg hatch, movement of crawlers or the occurrence of disease infection can be predicted and used to schedule inspection and spray programs.

There are several methods used to calculate GDD, but the method commonly used with simple monitoring equipment is the averaging method or "max/min" method. GDD for a given organism are calculated as follows:

$$\text{GDD} = \frac{(\text{Daily max °C}) + (\text{Daily min °C})}{2} - \text{min. base °C}$$

Growing Degree-Days are accumulated daily until a pest-specific total is reached. The averaging method works well in most years. However, the actual GDD accumulations may be underestimated in extended periods of cool weather or overestimated in hot weather.

An **example** of the averaging method on a relatively cool spring day:

For a given pest:
Lower base temperature = 10°C
Upper base temperature = 35°C

On a given day:
Minimum temperature = 5°C
Maximum temperature = 15°C

Growing degree-days (GDD) for that day
= (15+5)/2 – 10 = 0

Note that the maximum temperature was higher than the base temperature for the insect, so growth and development were possible for at least part of the day. However, no GDD were accumulated. This illustrates how cool temperatures, especially over several days, could lead to an underestimation of insect development.

Growing Degree-Days are either accumulated from a set start date, such as April 1, or from a specific event known as a biofix. A biofix is a biological event or indicator of a developmental event that initiates the beginning of GDD calculations. A common biofix used for insects is the first sustained catch in pheromone traps. A sustained catch is the start of a period of pest activity, which continues for at least two consecutive collection periods. To determine the first sustained catch in pheromone traps, ignore early sporadic catches. It is important to have pheromone traps set for 1–2 weeks before the first flight of the pest is expected.

Using a biofix provides predictions that are more accurate and requires tracking temperatures over a shorter period.

There are several limitations to degree-days models:

- Factors such as humidity, light intensity and rainfall also affect pest development. As a result, GDD predictions are only estimates of pest development. Verify these predictions with field observations.
- Temperatures used to determine GDD must represent the environment where organisms develop. If possible, use weather data collected from within a mile or less of the actual field being monitored. Site specific information can be obtained by using data loggers. Ventilated heat shields should be used with data loggers to ensure accurate air temperatures. Place data loggers at locations in the crop where the pest is normally active.

GDD models have been developed and validated for several vegetable pests in Ontario. Refer to *Ontario CropIPM* for detailed information on degree-day models for vegetable pests.

For a list of available crop consultants providing monitoring services, contact OMAFRA's Agricultural Information Contact Centre at 1-877-424-1300, or the nearest OMAFRA Resource Centre.

Pest Control Measures

Cultural and Mechanical

Integrated pest management incorporates cultural and mechanical practices to prevent or delay the development of pest outbreaks. Management tools include:

- site selection
- crop rotation
- resistant/tolerant cultivars
- certified seed
- treated seed
- sanitation
- elimination of alternative hosts
- inter-cropping
- water management
- optimized plant health
- barriers (i.e., row covers)

Crop Rotation for Control of Diseases

Crop rotation can be an important practice for preventing some diseases caused by fungi, bacteria and nematodes. Rotation with non-susceptible crops for 3 years usually allows enough time for infected plant material in the soil to completely decompose. In the absence of susceptible plant material, these organisms die off. For some soil-borne pathogens, such as phytophthora in peppers and cucurbit crops, a rotation longer than 3 years may be required.

Rotation only works when successive crops are not susceptible hosts. It is important to remember that plants in the same family (i.e., potatoes, tomatoes, peppers and eggplant) may all be susceptible to the same disease organisms. Do not rotate with plants in the same family.

Some diseases that are spread by wind or by insects may not be controlled by crop rotation. For example, some leaf blight organisms and powdery mildew fungi can blow into fields from neighbouring weeds and infested fields. However, crop rotation will reduce the level of many disease-causing organisms that remain on crop residue left in a field.

Chemical Controls

Chemical controls include synthetic, inorganic and biological pesticides. They kill target pests and limit subsequent populations. They are important tools for crop protection when used as part of an IPM program.

Understand the pest's life cycle and apply chemicals at the stage when the pest is most vulnerable. Select the appropriate product for the target pests.

To control insects, monitor fields closely. Spray according to action thresholds or at critical stages of crop development.

To control disease, apply fungicides prior to disease infection and development. Use factors such as weather conditions, crop stage and (where available) disease prediction models to indicate fungicide spray timing.

Insect Control in Vegetable Crops During Bloom

Healthy bee populations are an essential element to many vegetable operations. Honeybees provide pollination services or may enter other fields looking for an alternate source of pollen or water.

Many insecticide labels have specific wording pertaining to applications during bloom. Most insecticides are grouped into three categories: do not use on flowering crops or weeds, do not apply to flowering crops or weeds if bees are visiting the treated area, and avoid spraying when bees are foraging (see *Precautions for Spraying Insecticides During Bloom*, below). See *Bee Poisoning*, on page 16, for information on bee poisoning.

Precautions for Spraying Insecticides During Bloom

Do not use during crop or weed flowering period.

Lorsban 15G	Movento	Pyrinex 480 EC
Lorsban 50W	Nufos 4E	Pyrifos 15 G

Do not apply to flowering crops or weeds if bees are visiting the treated area.

Actara 25 WG	Delegate WG	Lorsban 4E
Actara 240 SC	Diazinon 500 E	Malathion 85 E
Admire 240 F	Diazinon 50 W	Malathion 25 W
Agri-mek 1.9%	Entrust 80 W	Matador 120EC
Alias 240 SC	Grapple$_2$	Orthene 75 SP
Assail 70 WP	Fulfill 50 WG	Sevin XLR
Clutch 50 WDG	Imidan 50 WP	Success 480 SC
Concept	Lagon 480	Thiodan 4EC
Cygon 480	Lannate TNG	Thionex 50 WP
Silencer 120EC	Vydate L	

Avoid spraying when bees are foraging.

Ambush	Monitor	Ripcord
Decis	Pounce	Rimon
Dibrom	Perm-UP	UP-Cyde

Biopesticides

Biopesticides are derived from natural materials such as plant extracts, bacteria and minerals. In Canada, biopesticides are divided into two major classes, microbial pesticides and biochemical pesticides.

Microbial pesticides contain a beneficial microorganism, such as a bacterium, fungus, virus or protozoan, as the active ingredient. They are relatively specific to their target pest. Microbial pesticides registered for use in vegetables include *Bacillus subtilis* and the various subspecies and strains of *Bacillus thuringiensis.*

Biochemical pesticides are naturally occurring substances and/or their synthetic analogues. A synthetic analogue is a manufactured molecule that resembles a naturally occurring substance. They generally control pests by different mechanisms than conventional pesticides or by making crops unsuitable for feeding. While many biopesticides are less toxic and pose a lower risk than conventional pesticides, some can be quite toxic.

Although many biopesticides are formulated, packaged and applied in a similar fashion to conventional pesticides, it is important to remember that the active ingredients on which they are based are often quite different. Biopesticides may require a specific timing of application, or they may only affect certain growth stages of the target pest.

Biopesticides, particularly those that are based on live microbes, are often highly sensitive to environmental conditions, such as heat or sunlight, which can reduce their effectiveness. Always consult the product label for specific usage instructions prior to application.

Table 1–1, *Biopesticides Used on Vegetable Crops in Ontario*, next page, lists the various registered biopesticides and their characteristics.

Table 1-1. Biopesticides Used on Vegetable Crops in Ontario

Common Name	Trade Name(s)[1]	Insecticide (i) Fungicide (f)	Crops Registered[1]	Notes
kaolin clay	Surround	i	carrots, celery, cucurbits, lettuce, parsley	This product leaves an insect-repelling white film on all plant parts. Re-application will be necessary following periods of heavy rain, overhead irrigation or rapid plant growth. Do not spray when bees are active in the crop.
Bacillus thuringiensis (Bt)	Novodor, Dipel, Thuricide, Bioprotec	i	beans, brassicas, celery, herbs, lettuce, parsley, potatoes, spinach, sweet corn, tomatoes	Bt is a stomach toxin and must be ingested by the target insect. It is most effective when applied to smaller instar larvae. Thorough coverage of the feeding area is essential.
potassium bicarbonate	Milstop Foliar fungicide	f	cucurbits, peppers	**Disease suppression only.** This contact fungicide kills certain types of fungi by pulling water from the spores and cell walls. It has little residual activity. Apply prior to the development of disease symptoms.
Bacillus subtilis	Serenade	f	celery, lettuce, onions	**Disease suppression only.** This beneficial bacterium colonizes plant parts and helps prevent plant pathogens from becoming established. Apply prior to the development of disease symptoms. Copper is toxic to *B. subtilis*. Do not use in rotation with copper fungicides.
potassium salts of fatty acids	Opal Insecticidal Soap	i	herbs	Soaps work by coating the bodies of soft-bodied insects, smothering them and interfering with their cuticles. They must be sprayed directly onto the target insect and have no effect once the soap deposits have dried. Thorough coverage is essential. Apply when drying conditions are slow, and avoid use of hard water.
Streptomyces lydicus	Actinovate	f	peppers (greenhouse transplants and field), tomatoes (greenhouse transplants)	**Powdery mildew suppression only.** Actinovate contains live bacteria and should not be used with bactericides, such as fixed copper. Begin applications when conditions favour disease development. Additional applications every 7–14 days will be required.
Pseudomonas syringae	Bio-Save 10 LP	f	potatoes (post harvest)	This naturally occurring bacterium is commonly present on the surface of produce. The bacterium enters wounds on roots where pathogen spores live, competes for nutrients and can outgrow the pathogen at storage temperatures. Thorough coverage is critical, as the bacterium must enter wounds to be effective.
Coniothyrium minitans	Contans WG	f	fields to be planted to lettuce, snap beans, carrots, cabbage, tomato, celery	The spores of a naturally occurring soil fungus attack the white mould resting bodies (sclerotia). Apply Contans at least 3 months prior to the anticipated infection period to allow ample time for the sclerotia to be destroyed. Incorporation is required.
Gliocladium catenulatum	PreStop	f	greenhouse transplants of basil, parsley, thyme, dill	Beneficial fungi compete with pathogens such as *Pythium*, *Rhizoctonia* and *Fusarium*. Apply as a preventative treatment at planting. Do not tank-mix with other pesticides or fertilizers.
Trichoderma harzianum	RootShield	f	field lettuce, cucurbits, peppers, tomatoes	Naturally occurring soil fungi protect the transplant's root zone and feed upon pathogenic fungi including *Pythium*, *Rhizoctonia* and *Fusarium*.
Beauveria bassiana	Botanigard ES Botanigard 22 WP	i	pepper and tomato transplants	Fungal spores penetrate and invade soft-bodied insects, including aphids, thrips and white flies. Do not apply with fungicides or other insecticides.

[1] Where multiple trade names exist, not all crops are necessarily registered on each product. Always consult the product label for specific crop recommendations.

Beneficial Insects (Beneficials)

Beneficials are natural enemies of the crop pest. These predators (including parasites and pathogens) help suppress pest populations. Many beneficials occur naturally in the environment, others may be introduced to field or greenhouse production.

Beneficials will not completely eliminate damage by pests. However, once they are established, they can maintain pest populations at lower levels. They are also effective at controlling indirect pests such as aphids, leafhoppers and mites. Beneficials are less effective at keeping populations of direct pests (those attacking the harvested product) at levels acceptable for commercial production. One of the advantages of beneficial insects is that their activities can prevent or delay the development of pesticide resistance. Where possible, select chemical control products that will not harm the beneficials.

Pest Management for Organic Vegetable Growers

Pest management in organic vegetable production includes pest monitoring, field sanitation, crop rotation, the use of resistant varieties and other crop management practices to encourage beneficial insects and to minimize pest outbreaks.

All pest control products used on vegetable crops must be labelled and registered for the pest and for the crop on which they are used. In addition, products used for organic vegetable production must meet the requirements of the Canadian Organic Standards and any additional requirements of the local organic certification body. Products that have been reviewed and listed by the Organic Materials Review Institute (OMRI listed) may be acceptable for use in organic production if they are registered in Canada. However, they must also be approved by the certification body. Note that not all formulations of an active ingredient may be organically acceptable. For example, the biopesticide *Bacillus thuringiensis* is formulated into multiple products for vegetable crops, but only a few of these are acceptable for use by organic producers. Always check with your organic certification body to confirm which products are allowed for use in your situation.

There are several certification bodies serving Ontario farms and processors. Contact these organizations to get information on how to be certified. For more information on certification, as well as addresses and links to details of the organic regulations and standards, see the infosheet *Organic Food and Farming Certification* at www.ontario.ca/crops (click on Organic).

Resistance Management

Resistance is the ability of a pest to survive exposure to a pesticide that previously controlled it. Resistance to a pesticide develops after repeated exposure to a specific chemical or chemical family. A few naturally occurring resistant individuals survive after each spray, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually the resistant population dominates, and the pesticide loses efficacy.

There are many potential causes for pest control failures. Before assuming a population is resistant to a product, consider the following factors, which may affect the effectiveness of pest control products:

- product selection — Certain pest control products may work only under specific circumstances (i.e., pests to be controlled, weather and soil conditions, timing, etc.).
- water volume — See *Water Volumes*, on page 10.
- rate — Ensure that pest control products are applied at the rate(s) indicated on the label.
- calibration and coverage — See *Coverage*, on page 11.
- timing — Some pest control products may work on specific life stages of a pest.
- water pH — Some pest control products have water pH requirements.
- time required for knockdown of pest — Some pest control products have delayed effects.
- weather conditions — See *Air Temperature and Relative Humidity*, on page 11, and *Rainfall* and *Wind Speed & Drift*, on page 11.

Resistance to pesticides can develop very quickly. Do not use the same chemical repeatedly unless it is used in rotation with a different chemical or used in combination with other chemicals having a different mode of action.

Table 1–2. Insecticide Groups Based on Sites of Action
The classification scheme listed below is adapted from the Insecticide Action Committee Mode of Action Classification (IRAC) 7.1 (June 2011).

Group #	Primary Site of Action	Group Name	Product name(s)
1A[1]	Acetylcholinesterase inhibitors	carbamates[1]	Lannate TNG, Sevin XLR, Vydate L
1B		organophosphates	Agrox B-2, Agrox CD, Counter 15 G, Cygon 480, Diazinon 50 W, Diazinon 500 E, Dibrom, Imidan 50 WP, Lagon 480, Lorsban 4E, Lorsban 15 G, Malathion 25 W, Monitor 480, Nufos 4E, Orthene 75 SP, Pyrifos 15 G, Pyrifos 50 W, Pyrinex 480 EC, Thimet 15 G
2A	GABA-gated chloride channel antagonists	cyclodiene organochlorines	Thiodan 4EC, Thionex 50 W
3A	Sodium channel modulators	pyrethroids	Ambush 500EC, Concept, Decis 5 EC, Force 3.0 G, Matador 120EC, Perm-UP 3.2 EC, Pounce 384EC, Ripcord 400 EC, Silencer 120 EC, UP-Cyde 2.5 EC
4A	Nicotinic acetylcholine receptor agonists	neonicotinoids	Admire 240 F, Assail 70 WP, Actara 240 SG, Actara 25WG, Alias 240 EC, Clutch, Concept, Cruiser 5 FS, Cruiser PSP, Gaucho 480 FL, Grapple$_2$, Poncho 600, Titan ST
5	Nicotinic acetylcholine receptor allosteric activators	spinosyns	Success 480 SC, Entrust 80 W, Delegate WG
6	Chloride channel activators	avermectins	Agri-mek 1.9%
8	Non-specific inhibitors	chloropicrin	Chloropicrin 100, Pic Plus
9B	Selective homopteran feeding blockers	pymetrozine	Fulfill 50 WG
9C		flonicamid	Beleaf 50SG
11	Microbial disruptors of insect midgut membranes	biological	Novodor, Dipel 2X DF, Thuricide, Bioprotec CAF
15	Inhibitors of chitin biosynthesis, type 0	benzoylureas	Rimon 10 EC
17	Moulting disruptor, dipteran	cyromazine	Citation 75WP, Governor 75 WP
23	Inhibitors of acetyl CoA carboxylase	tetronic and tetramic acid derivatives	Movento 240 SC, Oberon
28	Ryanodine receptor modulators	diamides	Coragen
NC	not classified		Surround, BotaniGard 22WP, BotaniGard ES

[1] Although sharing the same primary target site, it is possible that not all members of a single major mode of action (MoA) class have been shown to be cross-resistant. However, for the purposes of this classification system, it should be assumed that cross-resistance exists between compounds in any one sub-group.

Many chemicals with the same active ingredients are marketed under different brand names. For example, the insecticide chlorpyrifos is marketed under the brand names Lorsban, Pyrifos, Nufos and Pyrinex.

Different chemicals may also have the same mode of action. For example, both Assail and Admire, although different chemicals, have the same mode of action. Using Assail after Admire is equivalent to using Assail after Assail, since resistance to both chemicals develops at the same time, even though only one may have been used repeatedly.

Certain pests are more prone to develop resistance to pesticides than others. Pests with a short life cycle and many generations per growing season are more likely to develop resistance. Pests are more likely to develop resistance to pesticides that have a single mode or site of action than to those with multiple modes of action.

See Table 1–2, *Insecticide Groups Based on Sites of Action*, this page, and Table 1–3, *Fungicide Groups Based on Mode of Action*, opposite page, for a list of chemical families and their modes of action.

The pest control tables in Chapter 3, *Crop Protection*, starting on page 21, list the chemical group for each control product. Over the course of the season, rotate between products from different chemical groups.

Table 1–3. Fungicide Groups Based on Mode of Action
This classification scheme is based on the Fungicide Resistance Action Committee (FRAC) List, 2011.

Group #	Primary Site of Action	Group Name	Product Name(s)	Risk of Developing Resistance
1	Inhibition of mitosis (tubulin formation)	methyl-benzimidazole carbamates	Senator 70WP	High
2	Affect cell division, DNA & RNA synthesis & metabolism	dicarboximides	Rovral	Medium to High
3	Inhibition of sterol synthesis	DMI (demethylation inhibitors)	Bumper 418 EC, Inspire Fungicide, Mission 418 EC, Nova 40 W, Proline 480 SC, Tilt 250E, Topas 250E	Medium
4	Affect RNA synthesis	phenylamides	Allegiance FL, Apron FL, Apron Maxx, Apron XL LS, Ridomil 1G, Ridomil Gold 480SL, Ridomil Gold MZ, Ridomil Gold MZ 68WG	High
7	Fungal respiration	SDHI (succinate dehydrogenase inhibitors)	Cantus WDG, Lance WDG, Vitaflo 280, Pristine WG	Medium to High
9	Methionine biosynthesis	anilino-pyrimidines	Scala SC, Switch 62.5 WG	Medium
11	Fungal respiration	QoI (quinone outside inhibitors)	Cabrio EG, Dynasty 100FS, Headline EC, Pristine WG, Quadris, Reason 500SC, Tanos 50 DF	High
12	Osmotic signal transduction	phenylpyrroles	Apron Maxx, Maxim 480FS, Maxim MZ, Scholar 62.5 WG, Scholar 50 WP	Low to Medium
13	Osmotic signal transduction	aza-naphthalenes	Quintec	Medium
14	Lipid peroxidation (proposed)	aromatic hydrocarbons	Botran 75 W	Low to Medium
17	Sterol biosynthesis in membranes	hydroxyanilides	Decree 50 WDG	Low to Medium
21	Fungal respiration	QiI (quinone inside inhibitors)	Ranman 400SC	Medium to High
22	Mitosis and cell division	benzamides	Gavel 75 DF	Low to Medium
25	Protein synthesis	antibiotic	Streptomycin	High
27	Unknown	cyanoacetamide oxime	Curzate 60 DF, Tanos 50 DF	Low to Medium
28	Cell membrane permeability (proposed)	carbamates	Tattoo C	Low to Medium
29	Uncoupler of oxidative phosphorylation	2,6-dinitroanilines	Allegro 500F	Low
33	Unknown	phosphonates	Aliette WDG	Low
40	Cell wall synthesis (cellulose synthase)	carboxylic acid amides	Acrobat 50 WP, Revus	Low to Medium
43	Delocalization of spectrin-like proteins	benzamides	Presidio Fungicide	Unknown
44	Microbial disrupters of pathogen cell membranes	microbial	Contans WG, Prestop, Rootshield HC, Rootshield Granules, Serenade ASO, Serenade Max	Low
M1	Multi-site, contact	inorganic	Copper Spray, Copper 53W, Kocide DF, Kocide 2000, Oxidate, Parasol WG, Coppercide WP	Low
M2	Multi-site, contact	inorganic	Microthiol Disperss, Microscopic Sulphur	Low
M3	Multi-site, contact	dithiocarbamates	Acrobat 50 WP, Dithane, Dithane F 45, Ferbam 76 WDG, Gavel 75 DF, Manzate DF, Maxim MZ, Penncozeb 80WP, Polyram DF, Solan MZ, Thiram 75 WP, Vitaflo 280	Low
M4	Multi-site, contact	phthalimides	Agrox B-2, Agrox CD, Captan, Folpan 80 WDG, Maestro 80DF, Supra Captan 80 WDG	Low
M5	Multi-site, contact	chloronitriles	Bravo 500, Echo 90DF, Echo 720, Tattoo C	Low
NC	Not Classified	Not classified	MilStop, Superior 70 Oil	Resistance not known

Steps to Delay the Development of Pesticide Resistance

- Rotate between products from different chemical groups. Avoid the repeated use of any one pesticide or group of pesticides.
- Follow the pesticide label. Many products make specific recommendations about the maximum number of sequential applications and the maximum number of total applications permitted in one season.
- When applying a pesticide, use the appropriate rate, timing, water volume, nozzle selection and water pH.
- Ensure the sprayer is well maintained and properly calibrated.
- Follow an IPM program that makes use of a variety of different pest management strategies, including monitoring, crop rotation, cultural, biological and chemical options.
- Spray insecticides only when necessary. Use established thresholds where available.
- Apply fungicides preventatively before disease occurs. Wherever possible, follow disease prediction models. Applying fungicides in an attempt to eradicate a disease after it has become established is rarely effective and can increase the risk of selecting for resistant populations of the pathogen.
- When tank-mixing pest control products, ensure that each component belongs to a different chemical group with a different mode of action.
- If you experience a control failure after using a registered product, do not reapply the same pesticide.
- Keep accurate records of the type of product used during each application throughout the season.

Resistance can be costly to the grower. The development and registration of new products is expensive and time-consuming. Judicious use of pesticides will help reduce the development of resistant populations and conserve the effectiveness of existing products.

Spraying Vegetable Crops

Water Volumes

Most insecticides/fungicides are applied with 135–450 L/ha of water. Herbicide applications range from 55–350 L/ha. Many fungicide labels specify a specific minimum water volume to ensure adequate spray coverage of plant surfaces and optimize the product's performance. Confirm spray coverage using *water-and-oil sensitive paper placed in target* locations within the crop. See *Coverage*, opposite page.

Nozzle Selection

All agricultural spray nozzle manufacturers classify the output rate and range of droplet sizes produced by each of their nozzles. This information appears in their catalogues as tables linking droplet size classification to nozzle size (output rate typically in U.S. gallons per minute) and spray pressures (typically in pounds per square inch).

The American Society for Agricultural and Biological Engineers (ASABE) Standard S-572 droplet size classifications include:

VF = Very Fine
F = Fine
M = Medium
C = Coarse
VC = Very Coarse
XC = Extremely Coarse

Most fungicides and insecticides require medium or medium-to-fine spray droplets. Fine or very fine droplets are easily carried off by the wind or evaporate before hitting the target, resulting in poor spray coverage. Poor spray coverage is a common cause of control failures. Coarse or very coarse sprays will greatly reduce the possibility of herbicide spray drift but should be used with higher spray volumes to provide sufficient coverage of plant surfaces for insecticides or fungicides.

Table 1–4, *Sample Droplet Size Classification Chart*, this page, is an example of droplet size charts often used by nozzle manufactures. It is important to select the right type of nozzle for the spray job and to operate it at the right pressure to produce the appropriate droplet size.

Table 1–4. Sample Droplet Size Classification Chart

Examples of Nozzle Types	PSI					
	40	50	60	70	80	90
Hollow cone	F	F	F	VF	VF	VF
Flat fan	M	M	F	F	F	F
Drift reducing flat fan	C	C	M	M	M	M
Low pressure air induction flat fan	C	C	C	M	M	M
High pressure air induction flat fan	XC	XC	XC	XC	VC	VC

In the past, hollow cone nozzles were commonly used to apply fungicides or insecticides. When compared at the same pressure, hollow cones produce more droplets with a finer size than solid cone nozzles. Hollow cone nozzles are particularly suited to the application of wettable powders, flowables and suspensions and are effective in penetrating dense crop canopies such as field tomato. Solid cone nozzles emit higher volumes than hollow cones and are used when increased penetration into the crop canopy is required.

Flat fan nozzles evenly spaced according to the manufacturer's recommendations provide uniform spray distribution across the whole boom. They are frequently used for herbicide applications but are becoming more common for fungicide and insecticide application as well. The pumps on many large, self-propelled sprayers may not produce sufficient pressure to properly operate hollow-cone nozzles, which typically run at 50 psi and greater. There are a multitude of flat fan nozzle brands and types available to produce a medium or medium-to-fine spray at operating pressures less than 100 psi.

Coverage

Coverage can be defined as the number of discrete spray droplets per target area combined with the total area covered. For example, a single large droplet impinging on a leaf would not be as effective as 100 smaller droplets evenly distributed over the leaf surface, even though they deliver the same amount of product. Good coverage on the upper, and often lower, leaf surface is an essential component of the performance of many fungicide and insecticides.

Water-and-oil sensitive paper is a tool that can be used to assess spray coverage in the field. Table 1–5, *Water-and-Oil Sensitive Paper – Recommended Droplet Density*, this page, illustrates the manufacturer's recommended droplet density per square centimeter for insecticide, herbicide and fungicide applications.

Table 1–5. Water-and-Oil Sensitive Paper – Recommended Droplet Density

Number of droplets per square centimeter	Application Type
20–30	insecticides
20–30	herbicides (pre-emergence)
30–40	contact herbicides (post-emergence)
50–70	fungicides

Air Temperature and Relative Humidity

Pesticides can cause phytotoxicity or burning of plant foliage or flowers if applied during very hot weather (temperatures above 27°C). In hot conditions, avoid midday applications, as plants will be more prone to injury. The water droplets themselves can act as tiny magnifying lenses causing plant injury. Spraying during hot conditions may also cause a large portion of the spray droplets to evaporate before they hit the target, reducing efficacy and increasing drift. For more information on how weather can affect a spray application, see the OMAFRA Factsheet *How Weather Conditions Affect Spray Applications*, Order No. 09-037W (web only).

During conditions of high relative humidity (>80% relative humidity), the drying of the spray materials will be delayed. Slow and prolonged drying of pesticides can lead to phytotoxicity in some instances.

Synthetic pyrethroid insecticides (i.e., Ripcord, Decis, Pounce, Matador, etc.) break down quickly when air temperatures are above 27°C, reducing their effectiveness. If possible, apply these in the evening, when temperatures have dropped, or select a different product.

Rainfall

The decision to spray just prior to a rain or shortly after should be based on plant protection. This may be more critical when applying fungicides. Fungicides are most effective if the leaf is adequately covered prior to infection. Applications made after a rain event may allow disease organisms to invade unprotected plant tissue. Once they have dried, most fungicides can withstand about 2.5 cm of rainfall and still provide adequate protection.

Many preemergent herbicides are best applied before a rain. Moist soils allow for better distribution of the herbicide within the seed zone. Post-emergent applications are best applied after a rain or should be timed to allow adequate drying prior to rainfall.

Wind Speed & Drift

When applying fungicides and insecticides, moderate air movement helps move the product in and around the crop. In addition, light winds will help in the drying process. Optimum air movement is 3–8 km/h.

Do not spray when wind speeds are high or gusty. Drift is possible at lower wind speeds and in calm conditions. Drift potential is affected by the interaction of boom height, wind speed, temperature and droplet size. For more information on preventing pesticide drift, see *Manage Drift*, on page 16, and OMAFRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001.

2. Using Pesticides in Ontario

The information in this chapter is updated regularly. For up-to-date information, visit the OMAFRA website at www.ontario.ca/usingpesticides.

Read the latest product label before using a pesticide!

Review the *Grower Pesticide Safety Course Manual.*

Keep detailed spray records.

Federal Registration of Pesticides

Before a pesticide can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* (PCP Act) and be classified under the provincial *Pesticides Act.* The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticides for use in Canada following an evaluation of scientific data to ensure that the product has merit and value. It also ensures that the human health and environmental risks associated with its proposed use are acceptable.

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when following the label directions. Outcomes of a re-evaluation can be:

- no change in the registration
- label amendments (i.e., changes to personal protective equipment requirements, restricted entry intervals and buffer zones)
- modifications to existing maximum residue limits (MRLs)
- elimination or phasing-out of certain uses or formulations
- no further acceptance of the registration

The pesticide label is a legal document. It prescribes how the pesticide can be legally used. Off-label use is prohibited. It is against the law to use the pesticide in any other way or on any other crop or pest than as specified on the label. Labels for all registered pesticides are under Search Pesticide Labels on the PMRA website at www.pmra-arla.gc.ca. Ensure you have the most current label and are aware of any re-evaluation decisions.

Regulation of Pesticides in Ontario

The Ministry of the Environment (MOE) is responsible for regulating the sale, use, transportation, storage and disposal of pesticides in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09. All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.e-laws.gov.on.ca or by calling Service Ontario at 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

Before a federally registered pesticide can be sold or used in Ontario, it must be classified under the provincial *Pesticides Act.* The Ontario pesticide classification system consists of 11 classes. The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE the classification of pesticide products. Pesticide products are classified on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration, usage, federal class and registration status. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. Once approved by the MOE, classified products are posted on the MOE website at www.ontario.ca/environment.

Certification and Licensing

Growers and Their Assistants

Growers must be certified through the Grower Pesticide Safety Course in order to buy and use Class 2 and 3 pesticides on their farms. They do not require this certification to use Class 4, 5, 6 or 7 pesticides.

For information about certification for growers and training for assistants to growers, visit the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit the Ontario Pesticide Training and Certification website at www.ontariopesticide.com/index.cfm/home-page or call 1-888-620-9999 or 519-674-1575.

For more information about pesticide regulations, certification and licensing, see:

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.pmra-arla.gc.ca
- PMRA Pest Management Information Service: 1-800-267-6315 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment (MOE) website: www.ontario.ca/environment
- Regional MOE Pesticides Specialist (See Appendix B. Ontario Ministry of Environment — Regional Contact Information, on page <?>.)
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: www.ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com/index.cfm/home-page

Pesticide Application Information

When you decide to use a pesticide, choose the most appropriate formulation and application method for your situation. Use only a properly calibrated sprayer. Choose less toxic alternatives when possible. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. Read the most current pesticide label thoroughly before application. The label provides important information, such as:

- directions for use (rates of application, crops it can be used on, target pests, crop rotation restrictions, total number of applications, droplet size/nozzle type, application equipment, timing and ideal weather conditions)
- required personal protective equipment (PPE)
- hazard symbols and warnings
- restricted entry intervals
- buffer zones
- precautionary statements
- steps to be taken in case of an accident
- disposal

For more information on hazards, consult the Material Safety Data Sheet (MSDS) or contact the manufacturer.

For more information on pesticide application, see:

- OMAFRA Factsheet *Calibrating Airblast Sprayers*, Order No. 10-047
- OMAFRA Factsheet *Adjusting, Maintaining and Cleaning Airblast Sprayers*, Order No. 10-069
- OMAFRA Factsheet *How Weather Conditions Affect Spray Applications*, Order No. 09-037w (website only)
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/index.cfm/learning-resources/videos/
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies – Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097

Restricted Entry Intervals

The restricted entry interval, also referred to as Re-Entry Interval (REI), is the period of time following a pesticide application during which workers must not enter the treatment area. This allows any pesticide residue and vapours to dissipate from the treatment location (e.g., field), preventing the possibility of inadvertent pesticide exposure.

The PMRA reviews each pesticide to determine whether the label should include a specific restricted entry interval. If the restricted entry interval is not stated on the label for agricultural crops, assume that the REI is 12 hours. For golf courses and other residential turf, the spray solution must be dry before entry can occur. Some pesticides have labels

that carry a warning about working in treated crops and provide specific PPE requirements. Follow the label recommendations.

Days to Harvest for Food Crops (Pre-Harvest Intervals, Pregrazing and Feeding Intervals)

These intervals state the minimum time that must pass between the last pesticide application and the harvesting of the crop, or the grazing or cutting of the crop for livestock feed. If you harvest a crop before the pre-harvest interval (PHI) has passed, there may be pesticide residues in excess of the maximum residue limits (MRLs) set by PMRA.

"Up to the day of harvest" means the same as 0 days PHI; however, the REI may be more restrictive (i.e., a 12-hr restricted entry interval) and must be observed for harvesting that occurs on the day of application.

To avoid exceeding the maximum residue limits, always follow the directions on the label.

Buffer Zones

Buffer zones, or no spray areas, are areas left untreated to protect an adjacent sensitive area, such as sensitive terrestrial and aquatic habitats. Generally, a buffer zone is the downwind distance separating the point of direct pesticide application from the nearest boundary of a sensitive habitat.

Leave a suitable buffer zone between the treatment area and adjacent sensitive areas. Buffer zones may vary depending on the method of application (i.e., aerial, field boom, air blast). Check the pesticide labels for buffer zone requirements.

Sensitive terrestrial habitats include hedgerows, grasslands, shelterbelts, windbreaks, forested areas and woodlots.

Sensitive freshwater habitats include lakes, rivers, streams, creeks, reservoirs, marshes, wetlands and ponds.

Health Canada's Pest Management Regulatory Agency has an online spray drift calculator that allows applicators to modify the buffer zones specified on the product label, based on weather conditions, the category of sprayer or droplet size. For more information, see the Buffer Zone Calculator at www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce into water any material that may be harmful to fish or fish habitat. To protect these waters, applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned (if one is not specified on the pesticide label). The protected area includes the water body as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

Protect the Environment

Protect Water Sources

According to the British Crop Protection Council (BCPC), 40%–70% of surface water pesticide contamination comes from mixing and filling areas.

Where possible, load or mix pesticides on impermeable surfaces that are safely away from watercourses or environmentally sensitive areas. Collect drainage and run-off and dispose of it safely (*Your Guide to Using Pesticides,* BCPC 2007).

Clean your spray equipment away from wells, ponds, streams and ditches. Apply the diluted rinse water (usually at a ratio of 10:1) to the treatment area (crop) but do not exceed the pesticide rate recommended on the label.

Do not make a direct connection between any water supply (e.g., public supply, wells, watercourse or pond) and a spray tank. Use an anti-backflow device or intermediate system to prevent back-siphoning that could contaminate the water supply.

Immediately contain and clean up any spills to prevent contamination to water sources.

Check the pesticide label for specific instructions on water source protection.

For more information on protecting water sources, see:

- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097.
- OMAFRA Factsheet *Groundwater — An Important Rural Resource: Protecting the Quality of Groundwater Supplies*, Order No. 06-115
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13

Bee Poisoning

Honey bees, native bee species and other pollinating insects are important pollinators for many Ontario crops. Insecticides, some of which may negatively affect bees, are required for insect control but with careful management, both pollination and insect control can be achieved. Growers and licensed commercial exterminators can protect bees by following these suggestions:

- Before applying a pesticide, advise local beekeepers so they can move colonies out of the danger area. Contact the Provincial Apiarist at 1-888-466-2372, ext. 63595, for a list of the beekeepers in the area or see www.ontario.ca/crops and click "Apiculture" for a list of provincial bee inspectors who know the local beekeepers.
- Do not apply insecticides while fruit trees are in bloom. The *Bees Act* makes it an offence to do so in Ontario. Do not spray any flowering crop on which bees are foraging and read the pesticide label for guidelines.
- Time insecticide applications to minimize bee poisoning. Daytime treatments, when bees are foraging, are most hazardous. Insecticide applications in the evening are the safest. Spraying after 8 pm allows the spray to dry before the bees are exposed to it the next day. This is the most successful way to avoid bee damage. Early morning is the next best time, but spraying should be completed before 7 am. While honeybees and most other pollinating insects do not usually forage at temperatures below 13°C, bumblebees do. If you plan to spray in the morning, contact beekeepers who have bees within 10 km of your crop. The beekeepers will then have the option of taking protective action.
- Beekeepers can place wet bags in the entrance of the hive to disrupt the flight of the bees for up to 12 hr and provide more time for spray to dry. An opening of 2.5 cm on each side of the hive entrance is necessary so the bees can get out and ventilate the hive.
- Beekeepers should remove honeybee colonies as soon as pollination is complete and before any postbloom insecticides are applied.
- Honeybees may be poisoned by visiting weeds or cover crops, such as dandelions or clovers that are in bloom in the orchard or field. Avoid spray drift to blooming plants that are adjacent to the target field. Where possible, mow down such crops prior to a spray to help safeguard the bees.
- Do not apply insecticide on windy days to prevent drift toward nearby hives.
- If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to the bees according to *Precautions for Spraying Insecticides During Bloom*, on page 5. When there is a choice, choose a product formulation that is less hazardous to bees. EC formulations are usually less toxic than WP formulations.

Precautions for Spraying Insecticides During Bloom, on page 5, lists insecticides according to three categories: do not use on flowering crops or weeds, do not apply to flowering crops or weeds if bees are visiting the treated area and avoid spraying when bees are foraging.

Manage Drift

Pesticide drift is the aerial movement and unintentional deposit of pesticide outside the target area. Drift results in wasted product and compromised crop protection, and can adversely affect nearby sensitive environmental areas, crops and wildlife. The following strategies can help reduce the risk of pesticide drift:

- Do not spray when wind speeds are high or gusty. These conditions increase the potential for spray drift. Check pesticide labels for allowable wind speeds for spraying applications. Some labels may not provide this specific information. Constantly monitor wind conditions during spraying, using a good quality wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as adjusting water volume upwards, minimizing nozzle-to-target distance, changing nozzle technology, changing fields because of surrounding influences or stopping spraying until conditions improve.

- Do not spray during periods of dead calm. Periods of dead calm may occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher and can result in the spray droplets remaining aloft, like fog. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas.
- Use the recommended sprayer output.
- Use a nozzle that will produce the appropriate droplet size if specified on the pesticide label. Nozzles that produce fine droplets are rarely, if ever, required.
- Use the most appropriate nozzle for the type of application. Where practical, use air induction/venturi nozzles, which significantly reduce drift when compared to conventional nozzles.
- Check the height of the boom to the target, or distance from airblast boom to the target, and minimize the distance as much as possible while still maintaining spray uniformity.
- Follow buffer zone requirements for the protection of adjacent sensitive areas as outlined on the pesticide label.
- Use spray plume protection where practical or available (hoods, shrouds, screens and air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label. Sprayer agitators (e.g., paddle or hydraulic return) have been shown to reduce the effectiveness of certain drift-reducing adjuvants.
- Use wick weeders instead of spraying when possible.
- Use non-volatile pesticide formulations or products when possible.

For more information about spray drift, see:

- OMAFRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos *How to Manage Spray Drift* and *Spray Drift Reduction Through Air Induction*, available at www.opep.ca/index.cfm/learning-resources/videos/chapter-19-drift-of-pesticides/

Pesticide Disposal

Empty Pesticide Containers (up to 23 L)

Never re-use empty containers.

The Ontario Empty Pesticide Container Recycling Program is available free of charge to growers and commercial applicators. Through this program, you can return triple-rinsed or pressure-rinsed plastic pesticide containers (up to 23 L) to pesticide container collection depots located throughout the province. Remove the cap and booklet from the pesticide container before recycling. To locate the closest pesticide container collection depot, visit the CleanFARMS™ website at www.cleanfarms.ca, call your local dealer or call CleanFARMS™ at 416-622-4460.

Empty Pesticide Containers (greater than 23 L)

Growers and commercial applicators can return expired pesticide containers that are greater than 23 L in size. Contact your local dealer for details on disposal of these containers or call CleanFARMS™ at 416-622-4460.

Surplus Spray Mix

The best approach to disposing of surplus spray mix is to avoid creating it by planning the spray job accurately.

When this is unavoidable, dispose of excess spray mix by spraying it on other crops that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that other crop.

If you cannot find another crop to spray, dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or surplus spray mix disposal.

Never re-spray the treated field with undiluted spray mix. Spraying an area twice will double the recommended pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Surplus Pesticides in Storage

Be sure to safely dispose of pesticides that you do not need or cannot use. Options for proper disposal include:

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes. Look in the Yellow Pages of your telephone directory under Liquid Waste Removal.
- Check your local paper or visit the CleanFARMS™ website (www.cleanfarms.ca) for upcoming Obsolete Pesticide Collection Days.
- Contact your municipality to see if any waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for pesticide storage facilities. The storage requirements that must be followed are dependent on which classes of pesticides you store.

	Pesticide Classes			
Storage requirements	**2**	**3**	**4, 5 & 7**	**6**
No contact with food or drink	✔	✔	✔	✔
Not an impairment to health and safety	✔	✔	✔	
Clean and orderly	✔	✔	✔	
Warning sign G posted*	✔	✔	✔	
Emergency telephone numbers posted**	✔	✔	✔	
Vented to outside	✔	✔		
Limited access (locked)	✔	✔		
No floor drain	✔	✔		
Respiratory protection and protective clothing kept readily available	✔	✔		
Area used primarily for pesticides	✔			

Note: Sufficient precautions are needed in your storage area to prevent the pesticide from entering the natural environment. Ensure your floor drain does not enter the natural environment.

* Refer to MOE's website www.ene.gov.on.ca/en/land/pesticides for requirements for warning sign G. These signs can be purchased from your pesticide dealer/vendor.

** Emergency contact numbers must include telephone numbers for the local fire department, hospital and poison control centre. The number for the MOE Spills Action Centre (1-800-268-6060) should also be readily available.

For more information about storing pesticides, see:

- OMAFRA Factsheet, *Farm Pesticide Storage Facility,* Order No. 11-005
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application,* Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Grower Pesticide Safety Course Manual,* available at www.opep.ca. Select *Learning*.

Pesticide Spills

If a pesticide spill causes, or is likely to cause, an adverse effect that is greater than that which would result from the proper use of the pesticide, you must notify the Ministry of the Environment Spills Action Centre at 1-800-268-6060 (24 hr a day, 7 days a week) and your municipality.

A spill is defined as a discharge of pollutant that is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An incident such as an overturned pesticide sprayer that results in the loss of the spray solution to the environment is an example of a spill. A pesticide container that ruptures and leaks its contents is another example of a spill. The discharge or spraying of a pesticide in an unapproved area, commonly referred to as an overspray, is also considered a spill.

Before you begin to clean up a spill of any nature, remember to protect yourself against pesticide exposure. Wear the proper protective clothing and personal protective equipment. If the spill occurs inside an enclosed area (e.g., a pesticide storage area or a vehicle during transport), ventilate the area first. Once you have protected and/or removed yourself and other persons or animals from the spill site, take additional measures to stop the spill at the source and prevent it from spreading and/or contaminating watercourses. Specific precautions, emergency contact information and first aid procedures may be found on the label.

For minor spills, it may be possible to remediate the problem:

- **For a liquid spill** — Cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.
- **For a dust, granular or powder spill** — Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.

For major spills, it is essential to stop the spill from spreading. The clean-up guidelines above may not be appropriate for all spill situations. Once you have contained the spill, follow directions from the manufacturer and regulatory authorities on cleaning the contaminated area.

For information on preventing spills, see:

- OMAFRA Factsheet *Ways to Avoid Pesticide Spills*, Order No. 96-025
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Grower Pesticide Safety Course Manual*, available at www.opep.ca. Select *Learning*.

For pesticide poisonings and pesticide injuries, call:

Poison Information Centre:

1-800-268-9017

(TTY) 1-877-750-2233

For more information, see inside back cover on Emergency and First Aid Procedures for Pesticide Poisoning.

Do you know what pesticide drift looks like or what you can do about it?

OMAFRA and CropLife Canada have created two short videos with innovative visual demonstrations using dyes and night-spraying to show what drift actually looks like. See how spray particles behave and discover what changes can be made to your spray program to greatly reduce the risk of pesticide drift.

Learn more at www.ontario.ca/spraydrift.

3. Crop Protection

ASPARAGUS

Activities of products for asparagus diseases and insects are listed in Table 3–1, *Activity of Fungicides and Insecticides on Asparagus Diseases and Insects*. Products registered for asparagus diseases are listed in Table 3–2, *Asparagus Disease Control*. Products registered for asparagus insects are listed in Table 3–3, *Asparagus Insect Control*.

Table 3-1. Activity of Fungicides and Insecticides on Asparagus Diseases and Insects

Common Name	Trade Name	Aphids	Asparagus Beetle	Cutworms	Rust	Purple Spot (Stemphylium)
myclobutanil	Nova 40W				✔	
propiconazole	Topas 250E				✔	
	Mission 418 EC				✔	
metiram	Polyram DF				✔	
chlorothalonil	Bravo 500				✔	✔
azoxystrobin	Quadris					✔
lambda-cyhalothrin	Matador 120EC	✔	*			
	Silencer 120 EC	✔	*			
dimethoate	Lagon 480	✔				
	Cygon 480	✔				
deltamethrin	Decis 5 EC		✔			
cypermethrin	Ripcord 400 EC		✔			
	UP-Cyde 2.5 EC		✔			
carbaryl	Sevin XLR		✔	✔[1]		
malathion	Malathion 25W		✔			
spinetoram	Delegate WG		+			
spinosad	Entrust 80 W		✔			
	Success 480 SC		✔			
permethrin	Pounce 384EC			✔		
	Perm-UP			✔		
	Ambush 500EC			✔		

✔ = control
\+ = suppression
* = some control of this pest may be expected when the product is used to control labelled pests
blank cell = not registered for control of this pest

[1] Late-season (climbing) cutworms only.

Table 3-2. Asparagus Disease Control
Apply disease control products after harvest.

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
RUST						
DMI (group 3)	myclobutanil	Nova 40W	340 g	138 g		**Post-harvest use only.**
	propiconazole	Topas 250E	250 mL	101 mL	240	Apply at 14–21-day intervals.
		Mission 418 EC	150 mL	61 mL	240	
dithiocarbamate (group M3)	metiram	Polyram DF	2.25–3.25 kg	0.9–1.3 kg		**Post-harvest use only.** Use high rate on full-grown fern. Apply at 7–10-day intervals.
PURPLE SPOT (STEMPHYLIUM)						
chloronitrile (group M5)	chlorothalonil	Bravo 500	3.4 L	1.4 L	190	Will also provide rust suppression under low disease pressure conditions. 48-hr re-entry interval.
QoI (group 11)	azoxystrobin	Quadris	0.45–1.12 L	182–453 mL	180	Use high water volumes. Begin application prior to disease development. Use the low rate under low disease conditions. Spray intervals may be lengthened from 7–14 days, under low disease pressure conditions.

[1] PHI = Pre-Harvest Interval (days).

Table 3-3. Asparagus Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	180	**Post-harvest only.** 24-hr re-entry interval.
		Silencer 120 EC				
organophosphate (group 1B)	dimethoate	Lagon 480	2.3 L	0.9 L		**Post-harvest only.**
		Cygon 480				
ASPARAGUS BEETLE						
pyrethroid (group 3A)	deltamethrin	Decis 5 EC	200 mL	81 mL		**Apply after cutting only.**
	cypermethrin	Ripcord 400 EC	86 mL	35 mL	1	Apply when beetles are first observed. 12-hr re-entry interval.
		UP-Cyde 2.5 EC	140 mL	57 mL	1	
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–6.4 L	1–2.6 L	2	Use high water volumes. Do not treat more than once every 3 days.
organophosphate (group 1B)	malathion	Malathion 25W	5.5 kg	2.2 kg	1	
spinosyn (group 5)	spinetoram	Delegate WG	140–280 g	57–113 g	60	**Suppression only.** Apply at egg-hatch to small larvae. Use higher rates for heavy populations or larger larvae. 12-hr re-entry interval.
	spinosad	Entrust 80 W	88 g	36 g	60	Apply just after egg-hatch to small larvae.
		Success 480 SC	145 mL	59 mL		
CUTWORMS						
pyrethroid (group 3A)	permethrin	Pounce 384EC	180–390 mL	73–158 mL	2	**Use only the low rate during the cutting season.** Use high rate on dry soils. Use high rate on large cutworms. Do not disturb the soil surface for 5 days after treatment. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL	2	
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–6.4 L	1–2.6 L	2	**Late-season (climbing) cutworms only.** Do not treat more than once every 3 days.

[1] PHI = Pre Harvest Interval (days).

BEANS

Seed treatments registered on beans are listed in Table 3–4, *Bean Seed Treatments*. Activities of products for bean diseases are listed in Table 3–5, *Activity of Fungicides on Snap and Lima Bean Diseases*. Products registered for bean diseases are listed in Table 3–6, *Snap and Lima Bean Disease Control*.

Activities of products for bean insects are listed in Table 3–7, *Activity of Insecticides on Snap and Lima Bean Insects*. Products registered for bean insects are listed in Table 3–8, *Snap and Lima Bean Insect Control*.

Table 3–4. Bean Seed Treatments

		Insects			Seedling Blights					
Active Ingredient(s)	**Trade Name**	Seedcorn Maggots	Wireworm	Potato Leafhopper	Anthracnose	Phytophthora	Pythium	Fusarium	Rhizoctonia	**Notes**
thiamethoxam + metalaxyl-M/ fludioxonil	Cruiser 5FS + Apron Maxx RFC	✔	✔	✔	✔	*	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product labels for rates. Use the high rate of Cruiser for wireworm control. Also controls early-season soybean aphids.
diazinon/ captan	Agrox B-2	✔					✔	✔	✔	**Seed box or slurry treatment.** Use 80 g per 25 kg of seed. Do not use on seed previously treated with an insecticide. Plant seeds within 1 month of treatment.
diazinon/ captan	Agrox CD	✔					✔	✔	✔	**Seed box treatment.** Use on seed previously treated with captan or thiram. Use 50 g per 25 kg of seed. Do not use on seed previously treated with an insecticide.
copper hydroxide	Kocide 2000									**Suppression of seed-borne bacterial diseases** (common blight, halo blight and bacterial brown spot). Use 113 g per 100 kg of seed in 200 mL of water. May delay germination.
fludioxonil/ metalaxyl-M	Apron Maxx RFC				✔	*	✔	✔	✔	**For use in commercial or on-farm seed-treatment equipment only.** Use 100 mL per 100 kg of seed.
metalaxyl-M	Apron XL LS					✔	✔			**For use in commercial seed-treatment plants only.** See the product label for rates.
metalaxyl	Allegiance FL						✔			**For use in commercial seed-treatment plants only.** See the product label for rates.
carbathiin/ thiram	Vitaflo				✔		*	*	✔	**Snap beans only.** **For use in commercial seed-treatment plants only.** See the product label for rates. Do not store treated seed.
thiram	Thiram 75 WP						✔	✔	✔	**Seed box treatment.** Use 25–30 g per 25 kg of seed.
Trichoderma harzianum	RootShield HC						+	+	+	**Seed box treatment.** 60–125 g/50 kg of seed.
thiamethoxam	Cruiser 5 FS	✔	✔	✔						**For use in commercial seed-treatment plants only.** See product label for rates. Request the high rate for wireworm control. Also controls early-season soybean aphid.
imidacloprid	Gaucho 480 FL			✔						**For use in commercial or on-farm seed-treatment equipment only.** Use 130 mL per 100 kg of seed. Carry-over of Gaucho-treated seed is not recommended.

✔ = registered pest
* = some control of this pest may be expected when the product is used to control labelled pests
+ = suppression

Table 3–5. Activity of Fungicides on Snap and Lima Bean Diseases[1]

Common Name	Trade Name	Root Rots	Bacterial Blights	White Mould (Sclerotinia)	Anthracnose	Angular Leafspot	Rust
copper hydroxide	Parasol WG		✔				
	Coppercide WP		✔				
	Kocide 2000		✔				
boscalid	Lance WDG			✔			
fluazinam	Allegro 500F			✔			
cyprodinil/ fludioxonil	Switch 62.5 WG			✔			
iprodione	Rovral			✔			
dicloran	Botran 75 W			✔			
Coniothyrium minitans	Contans WG			+			
pyraclostrobin	Headline EC				*	✔	✔
metalaxyl-M	Ridomil Gold 480SL	✔					

✔ = control
\+ = suppression
* = some control of this pest may be expected when the product is used to control labelled pests
blank cell = not registered for control of this pest

[1] For seed decay and root rots, see Table 3–4, *Bean Seed Treatments*, opposite page.

Table 6. Snap and Lima Bean Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
BACTERIAL BLIGHT (HALO AND COMMON)						
inorganic (group M1)	copper hydroxide	Parasol WG	2.25–3.25 kg	0.9–1.3 kg	1	Make first application when plants are 15 cm (6 in.) high. 48-hr re-entry interval.
		Coppercide WP				
		Kocide 2000	1.6–2.3 kg	0.6–0.9 kg	1	
WHITE MOULD (SCLEROTINIA)						
SDHI (group 7)	boscalid	Lance WDG	560–770 g (use 420 g for grey mould control)	227–312 g (use 170 g for grey mould control)	7	Spray at 20%–50% bloom with a second application 7 days later. 12-hr re-entry interval.
2,6-dinitroanilines (group 29)	fluazinam	Allegro 500F	1 L	0.4 L	14	Spray at 10% bloom with a second spray 7 days later. 24-hr re-entry interval.
anilino-pyrimidines/ phenylpyrroles (group 9/12)	cyprodinil/ fludioxonil	Switch 62.5 WG	775–975 g	314–395 g	7	Spray at 10%–20% bloom. Repeat after 7 days if the conditions remain favourable for disease development. Use the higher application rate under conditions of high disease pressure. 12-hr re-entry interval.
dicarboximide (group 2)	iprodione	Rovral	1.5 kg	0.6 kg	15	**Snap beans only.** Spray at 50% bloom. Aerial application permitted. 12-hr re-entry interval.
aromatic hydrocarbons (group 14)	dicloran	Botran 75W	3.25 kg	1.3 kg	2	**Snap beans only.** Spray at first bloom. Do not feed treated foliage to livestock. 12-hr re-entry interval.
microbial (group 44)	*Coniothyrium minitans*	Contans WG	2–4 kg	0.8–1.6 kg		**Snap beans only.** Suppression. Apply to soil prior to or at planting. Broadcast and lightly incorporate.
ANGULAR LEAFSPOT AND RUST						
QoI (group 11)	pyraclostrobin	Headline EC	400 mL	162 mL	7	**Snap beans (angular leaf spot control).** 12-hr re-entry interval.
			400–600 mL	162–243 mL	7	**Lima beans (rust control).** 12-hr re-entry interval.
PYTHIUM DAMPING-OFF, PHYTOPHTHORA ROOT ROT						
phenylamides (group 4)	metalaxyl-M	Ridomil Gold 480SL	2.3 mL/ 100 m of row[2]	0.7 mL/ 100 ft of row		**Snap beans only.** Make only 1 application/yr at planting. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] 76-cm row spacing, with a 20-cm spray band requires 300 mL/ha (121 mL/acre) of Ridomil Gold 480SL.

Table 3–7. Activity of Insecticides on Snap and Lima Bean Insects[1]

Common Name	Trade Name	Aphids	Leafhoppers	Slugs	Cutworms	European Corn Borer	Western Bean Cutworm	Mexican Bean Beetles	Bean Leaf Beetle	Spider Mites
lambda-cyhalothrin	Matador 120EC	✔	✔		✔	✔	✔	*	✔	
	Silencer 120 EC	✔	✔		✔	✔	✔	*	✔	
dimethoate	Cygon 480	✔	✔					✔	✔	✔
	Lagon 480	✔	✔					✔	*	✔
malathion	Malathion 85E	(✔)	✔					✔		✔
naled	Dibrom	✔								✔
carbaryl	Sevin XLR		✔					✔		
permethrin	Pounce 384EC					✔				
	Perm-UP					✔				
	Ambush 500EC					✔				
spinosad	Success 480 SC					✔				
	Entrust 80 W					✔				
Bacillus thuringiensis	Bioprotec CAF					✔				
methomyl	Lannate TNG					✔				
novaluron	Rimon 10 EC					✔				
chlorantraniliprole	Coragen				✔	✔	✔			
ferric phosphate	Sluggo Professional			✔						

✔ = control
(✔) = registered but not considered effective or resistance is documented
* = some control of this pest may be expected when the product is used to control labelled pests
blank cell = not registered for control of this pest

[1] For information on seed corn maggot and seed treatments for aphid and leafhopper control, see Table 3–4, *Bean Seed Treatments*, on page 24.

Table 3-8. Snap and Lima Bean Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
LEAFHOPPERS, BEAN BEETLES AND APHIDS						
pyrethroid (group 3A)	lambda-cyhalothrin[2]	Matador 120EC[2] Silencer 120 EC[2]	83–233 mL	34–94 mL	7	**Snap Beans.** Use low rate for leafhoppers. Use the higher rate to target higher aphid or bean leaf beetle populations. Aerial application permitted. 24-hr re-entry interval.
					14	**Lima Beans.** Use low rate for leafhoppers. Use the higher rate to target higher aphid or bean leaf beetle populations. Aerial application permitted. 24-hr re-entry interval.
organophosphate (group 1B)	dimethoate[2]	Cygon 480[2]	0.7–1 L	0.3–0.4 L	7	
		Lagon 480[2]	0.7–1 L	0.3–0.4 L	7	**Snap beans only.** Aerial application permitted.
	malathion	Malathion 85E	0.73–1.34 L	0.3–0.5 L	3	
	naled	Dibrom	1.1–2.2 L	0.4–0.9 L	4	**Lima beans only. Aphid control only.** Aerial application permitted. Do not apply when temperature is >32°C. 48-hr re-entry interval.
carbamate (group 1A)	carbaryl	Sevin XLR	2.5 L	1 L	5	**Leafhoppers.**
			1.25–1.5 L	0.5–0.6 L	5	**Mexican Bean Beetle.** Use low rate on young plants.
EUROPEAN CORN BORER						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	12-hr re-entry interval.
pyrethroid (group 3A)	lambda-cyhalothrin[2]	Matador 120EC[2] Silencer 120 EC[2]	83 mL	34 mL	7	**Snap beans.** Apply before corn borer larvae tunnel into the stalk or pods. 24-hr re-entry interval.
					14	**Lima beans.** Apply before corn borer larvae tunnel into the stalk or pods. 24-hr re-entry interval.
	permethrin	Pounce 384EC	260 mL	105 mL	7	**Snap beans only.** Aerial application permitted. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	200 mL	81 mL	7	**Snap beans only.**
benzoylureas (group 15)	novaluron	Rimon 10 EC	410–820 mL	166–332 mL	2	**Snap beans only.** Apply just prior to egg-hatch. 12-hr re-entry interval.
spinosyn (group 5)	spinosad	Success 480 SC	83 mL	34 mL	3	**Snap beans only.** Use only on small larvae and low infestations. Maintain a spray pH of 6 or greater.
		Entrust 80 W	50 g	20 g	3	
biological (group 11)	*Bacillus thuringiensis*	Bioprotec CAF	2.8–4.0 L	1.1–1.6 L	0	**Snap beans only.** Allow 5–10 days between applications.
carbamate (group 1A)	methomyl	Lannate TNG	550 g	223 g	7	**European Corn Borer.** 12-hr re-entry interval.
WESTERN BEAN CUTWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	12-hr re-entry interval.
pyrethroid (group 3A)	lambda-cyhalothrin[2]	Matador 120EC[2] Silencer 120 EC[2]	83–187 mL	34–76 mL	7	**Snap beans.** 24-hr re-entry interval.
					14	**Lima beans.** 24-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Do not graze or feed treated foliage to livestock.

Table 3–8. Snap and Lima Bean Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS						
pyrethroid (group 3A)	lambda-cyhalothrin[2]	Matador 120EC[2]	83 mL	34 mL	14	Apply in the late evening or at night. 24-hr re-entry interval.
		Silencer 120 EC[2]				
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	Apply to small plants when no rain is forecast in the next 24 hr. 12-hr re-entry interval.
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10–20 kg	0	Apply to moist soils. Use higher rates on severe infestations.

[1] PHI = Pre-Harvest Interval (days).
[2] Do not graze or feed treated foliage to livestock.

BEETS, TABLE

Seed treatments registered for table beets are listed in Table 3–9, *Table Beet Seed Treatments.* Activities of products for table beet diseases are listed in Table 3–10, *Activity of Fungicides on Table Beet Diseases.* Activities of products for table beet insects are listed in Table 3–11, *Activity of Insecticides on Table Beet Insects.* Products registered for table beet diseases and insects are listed in Table 3–12, *Table Beet Disease and Insect Control.*

Table 3–9. Table Beet Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	pythium damping-off	**Apply using commercial seed treatment equipment only.**
Maxim 480FS	fludioxonil	5.2–10.4 mL/ 100 kg seed	seed- and soil-borne diseases (*Fusarium, Rhizoctonia, Aspergillus, Penicillium*)	**For import use only.** Not for domestic commercial or on-farm seed treatment.
Thiram 75 WP	thiram	90 g/ 25 kg seed	seed decay, seedling blight, damping-off	

Table 3–10. Activity of Fungicides on Table Beet Diseases

Common Name	Trade Name	Rhizoctonia Root Rot Rhizoctonia Crown Rot Rhizoctonia Stem Canker	Cercospora Leaf Spot	Alternaria	Powdery Mildew	Botrytis Grey Mould
copper sulfate	Copper 53W		✔			
pyraclostrobin	Cabrio EG		✔	✔	✔	
azoxystrobin	Quadris Flowable	✔				
cyprodinil/ fludioxonil	Switch 62.5 WG					✔

✔ = control
blank cell = not registered for control of this pest

Table 3–11. Activity of Insecticides on Table Beet Insects

Common Name	Trade Name	Stink Bugs	Lygus Bugs	Flea Beetles	Cutworms	Aphids	Leafhoppers
permethrin	Pounce 384EC				✔		
	Perm-UP				✔		
	Ambush 500EC				✔		
flonicamid	Beleaf 50SG					✔	
dimethoate	Cygon 480					✔	✔
	Lagon 480		✔			✔	✔
diazinon	Diazinon 50 W					✔	
malathion	Malathion 25W					✔	
carbaryl	Sevin XLR	(✔)	✔	✔			✔

✔ = control
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

Table 3–12. Table Beet Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CERCOSPORA LEAF SPOT						
inorganic (group M1)	copper sulfate	Copper 53W	4 kg	1.6 kg	1	48-hr re-entry interval.
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	3	3-day re-entry interval (hand harvesting); 12-hr for other activities.
RHIZOCTONIA						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	40	One application/yr, applied in-furrow at planting or banded within 30 days of emergence.
CUTWORMS						
pyrethroid (group 3A)	permethrin	Pounce 384EC	180–390 mL	73–158 mL		Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. Use high rate on large larvae, dry soils or muck soils. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL		
APHIDS						
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	3	12-hr re-entry interval.
organophosphate (group 1B)	dimethoate	Cygon 480	700 mL	283 mL	12	**Beet greens only.**
		Lagon 480				
	diazinon	Diazinon 50 W	1.1 kg	0.45 kg	14	Less effective below 20°C. Control of aphids with diazinon has been inconsistent in many areas.
	malathion	Malathion 25W	2.25–5.5 kg	0.9–2.2 kg	7	Control of aphids with malathion has been inconsistent in many areas.
LEAFHOPPERS						
organophosphate (group 1B)	dimethoate	Cygon 480	700 mL	283 mL	12	**Beet greens only. Also registered for tarnished plant bug on beets (12-day PHI).**

[1] PHI = Pre-Harvest Interval (days).

BRASSICA CROPS

broccoli, Brussels sprouts, cabbage, cauliflower, horseradish, kale, kohlrabi and specialty vegetables, including headed Chinese cabbage (napa), leafy Chinese cabbage (bok choy, pak choy, etc.), Chinese mustard, broccoli raab, collards, mizuna, mustard greens, mustard spinach and rape greens

Seed treatments registered on brassica crops are listed in Table 3–13, *Brassica Crop Seed Treatments*. Activities of products for brassica crop diseases are listed in Table 3–14, *Activity of Fungicides on Brassica Crop Diseases*. Products registered for brassica crop diseases are listed in Table 3–15, *Brassica Crop Disease Control*.

Activities of products for brassica crop insects are listed in Table 3–16, *Activity of Insecticides on Brassica Crop Insects*. Products registered for brassica crop insects are listed in Table 3–17, *Brassica Crop Aphids, Cutworms and Slugs Control*, Table 3–18, *Brassica Crop Cabbage Maggot Control*, Table 3–19, *Brassica Crop Flea Beetles and Thrips Control*, Table 3–20, *Brassica Crop Imported Cabbageworm, Cabbage Looper, Diamondback Moth Caterpillar Control*, and Table 3–21, *Brassica Crop Swede Midge and Pea Leafminer Control*.

Table 3–13. Brassica Crop Seed Treatments

Trade Name	Active Ingredient	Rate	Pests Controlled	Notes
Maxim 480FS	fludioxonil	5.2–10.4 mL/ 100 kg seed	damping-off (*Fusarium, Rhizoctonia, Aspergillus* and *Penicillium*)	**For import use only.** Not for domestic, commercial or on-farm seed treatment.
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping-off (*Rhizoctonia solani*)	
Thiram 75 WP	thiram	90 g/ 25 kg seed	seedling blight and damping-off	Seed box treatment. For use on broccoli, Brussels sprouts, cabbage, cauliflower and mustard.

Table 3-14. Activity of Fungicides on Brassica Crop Diseases

Common Name	Trade Name	Damping-Off	Downy Mildew	Alternaria	White Rot	Powdery Mildew	Botrytis Grey Mould	Rhizoctonia	Clubroot
fludioxonil	Maxim 480FS	✔							
metalaxyl-M	Apron XL LS	✔							
azoxystrobin	Dynasty 100FS	✔							
thiram	Thiram 75 WP	✔							
captan	Maestro 80DF	✔							
chlorothalonil	Bravo 500		✔	✔					
	Echo 90DF		✔	✔					
fluopicolide + chlorothalonil	Presidio + Bravo 500		✔						
fosetyl-al	Aliette WDG		✔						
mandipropamid	Revus		✔						
copper sulfate	Copper 53W		✔						
difenoconazole	Inspire			✔		✔			
iprodione	Rovral			✔					
pyraclostrobin	Cabrio EG			✔		✔			
fenamidone	Reason 500SC		+						
pyraclostrobin/ boscalid	Pristine WG		+				✔		
Coniothyrium minitans	Contans WG				+				
Bacillus subtilis	Serenade ASO		+		+				
cyprodinil/fludioxonil	Switch 62.5 WG			+		✔	✔		
azoxystrobin	Quadris Flowable							✔	
fluazinam	Allegro 500F								✔[1]

✔ = control
\+ = suppression
blank cell = not registered for control of this pest
[1] Chemical control of clubroot is inconsistent.

Table 3–15. Brassica Crop Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
GREENHOUSE TRANSPLANT DISEASE CONTROL (DAMPING-OFF AND ROOT ROT)						
phthalimide (group M4)	captan	Maestro 80DF	1.25 kg/1,000 L of water Apply 50–85 L of solution per 100 m^2			Soil drench treatment. 48-hr re-entry interval.
CLUBROOT (TRANSPLANT TREATMENTS)[2]						
2,6-dinitroanilines (group 29)	fluazinam	Allegro 500F	Mix 50 mL with water to make a 100-L solution. Apply 100 mL per plant		65	**Head and stem brassica (e.g., cabbage, broccoli) transplant treatment.** Apply immediately after transplanting.
					30	**Leafy brassica greens (e.g., Chinese cabbage, mustards) transplant treatment.** Apply immediately after transplanting.
			2.9 L in 500 L water/ha		65	**Head and stem brassica, leafy brassica greens pre-transplant treatment.** Apply solution in a minimum band of 25 cm along the row and incorporate to a depth of 15–20 cm. If using transplants, plant the seedlings into the treated band or make a broadcast application prior to bed formation.
DOWNY MILDEW, ALTERNARIA, WHITE ROT						
chloronitrile (group M5)	chlorothalonil	Bravo 500	2.5–4.8 L	1–1.9 L	7	**Broccoli, Brussels sprouts, cabbage and cauliflower. Not on horseradish, kale or kohlrabi.** 48-hr re-entry interval.
		Echo 90DF	1.4–2.7 kg	0.6–1.1 kg	7	
benzamides + chloronitrile (group 43+M5)	fluopicolide + chlorothalonil	Presidio + Bravo 500	220–292 mL + 2.5–4.8 L	89–118 mL + 1–1.9 L	7	See label for complete list of registered brassica crops. Do not make sequential applications. See product label for rotational restrictions. 48-hr re-entry interval.
phosphonate (group 33)	fosetyl-al	Aliette WDG	2.25–3.125 kg	0.9–1.3 kg	7	**Broccoli and bok choy. Downy mildew only.** 12-hr re-entry interval.
inorganic (group M1)	copper sulfate[3]	Copper 53W[3]	4 kg	1.6 kg	1	**Broccoli, Brussels sprouts, cabbage and cauliflower.** 48-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	364–512 mL	147–207 mL	3	See label for complete list of registered brassica crops. Apply no more than 2 sequential applications. Maximum 2.04 L/ha per year. 12-hr re-entry interval. 24-hr re-entry interval for scouting. 3-day re-entry interval for hand harvesting or irrigation.
dicarboximide (group 2)	iprodione	Rovral	3 kg	1.2 kg	7	**Storage cabbage. Alternaria only.** Apply 7–14 days prior to harvest. 12-hr re-entry interval.
					5	**Cauliflower. Alternaria only.** Apply 1–2 days prior to tying. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Chemical control of clubroot is inconsistent.
[3] Fixed copper may be phytotoxic to cauliflower.

Table 3-16. Brassica Crop Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
QoI (group 11)	pyraclostrobin	Cabrio EG	0.56–1.1 kg	226–445 g	3	**Alternaria & cercospora control. Horseradish only.** Apply no more than 2 sequential applications. 12-hr re-entry interval. 3-day re-entry interval for hand-thinning.
	fenamidone	Reason 500SC	400–600 mL	162–243 mL	2	**Downy mildew suppression.** See label for complete list of all brassica crops, including specialty brassica. Begin applications when conditions are conducive to disease development. 48-hr re-entry interval.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	162–243 mL	1	**Downy mildew.** The use of a non-ionic adjuvant (0.25% v/v) is recommended. 12-hr re-entry interval.
SDHI/QoI (group 7/11)	pyraclostrobin/ boscalid	Pristine WG	1 kg	0.4 kg	4	**Downy mildew suppression. Botrytis grey mould.** See label for complete list of all brassica crops, including specialty brassicas. Use in rotation with fungicides from groups other than 7 or 11. 4-day re-entry interval.
microbial (group 44)	*Coniothyrium minitans*	Contans WG	2–4 kg	0.8–1.6 kg		**Cabbage only. Suppression of white rot.** Broadcast application, lightly incorporated. Apply to soil prior to or at planting or at time of transplant at least 3 months prior to typical onset of disease. Regular use of Contans WG in successive years within a long-term management strategy will improve disease control. If incorporation will displace soil greater than 5 cm, increase application rate to 3–6 kg/ha (1.2–2.4 kg/ha).
	Bacillus subtilis	Serenade ASO	8–15 L	3.2–6 L	0	**Suppression of downy mildew.** Begin applications when conditions are conducive to disease development. Repeat at 7–10-day intervals.
			12–24 L	4.8–9.7 L	0	**Suppression of white rot.** Begin applications when conditions are conducive to disease development. Repeat at 7–10-day intervals.
POWDERY MILDEW, BOTRYTIS GREY MOULD						
phenylpyrroles/ anilino-pyramidines (group 12/9)	cyprodinil/ fludioxonil	Switch 62.5 WG	775–975 g	314–395 g	7	**Mustard/turnip greens, horseradish and cabbage only.** Do not make more than 2 sequential applications. Use high rate for heavy disease pressure. 12-hr re-entry interval.
RHIZOCTONIA						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	40	**Horseradish only.** One application/yr; applied in-furrow at planting or banded soon after emergence.

[1] PHI = Pre-Harvest Interval (days).
[2] Chemical control of clubroot is inconsistent.
[3] Fixed copper may be phytotoxic to cauliflower.

Table 3-16. Activity of Insecticides on Brassica Crop Insects

Common Name	Trade Name	Aphids	Cutworms	Slugs	Two-Spotted Spider Mites	Cabbage Maggot	Flea Beetles	Thrips	Imported Cabbageworm	Cabbage Looper	Diamondback Moth	Swede Midge	Pea Leafminer
acetamiprid	Assail 70 WP	✔										✔	–
imidacloprid	Admire 240 F	✔											
flonicamid	Beleaf 50SG	✔											
spirotetramat	Movento 240 SC	✔										✔	
acephate	Orthene 75 SP	✔							✔	✔	✔		
dimethoate	Cygon 480	✔											
	Lagon 480	✔						✔					
methamidophos	Monitor 480	✔							✔	✔	✔		
naled	Dibrom	✔							✔	✔	✔		
imidacloprid/deltamethrin	Concept	✔					✔		✔	✔	✔		
cypermethrin	Ripcord 400 EC		✔				✔	✔	✔	✔	✔		
	UP-Cyde 2.5 EC							✔	✔	✔	✔		
permethrin	Pounce 384EC		✔				✔		✔	✔	✔		
	Perm-UP		✔				✔		✔	✔	✔		
	Ambush 500EC		✔				✔		✔	✔	✔		
chlorantraniliprole	Coragen		✔						✔	✔	✔	✔	
chlorpyrifos	Lorsban 4E		✔			✔							
	Pyrinex 480 EC		✔			✔							
	Nufos 4E		✔			✔							
	Lorsban 50W		✔			✔							
	Lorsban 15G					✔							
	Pyrifos 15G					✔							
ferric phosphate	Sluggo Professional			✔									
methomyl	Lannate TNG			✔					✔	✔	✔		
lambda-cyhalothrin	Matador 120EC						✔		✔	✔	✔	✔	
	Silencer 120 EC						✔		✔	✔	✔	✔	
deltamethrin	Decis 5 EC						✔		✔	✔	✔		
endosulfan	Thiodan 4EC	✔					✔		✔	✔	✔		
	Thionex 50 WP	✔					✔		✔	✔	✔		
	Thiodan 50 WP	✔					✔		✔	✔	✔		
carbaryl	Sevin XLR						✔		✔		✔		
spinosad	Success 480 SC							+	✔	✔	✔	–	
	Entrust 80 W						+	+	✔	✔	✔	–	
Bacillus thuringiensis	Dipel 2X DF								✔	✔	✔		
	Thuricide-HPC								✔	✔	✔		
	Bioprotec CAF								✔	✔	✔		
spinetoram	Delegate WG								✔	✔	✔		
novaluron	Rimon 10 EC								✔	✔	✔		
cyromazine	Citation 75WP												✔

✔ = control
\+ = suppression
– = reduction in damage
blank cell = not registered for control of this pest

Table 3–17. Brassica Crop Aphids, Cutworms and Slugs Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	See the label for a complete list of all brassica crops, including specialty brassicas. Alternate sprays with other insecticide families. 48-hr re-entry interval for scouting. 4-day re-entry interval for all other post-application activities.
	imidacloprid	Admire 240 F	730 mL	295 mL	21	**Side-dress application.** Inject to a depth of 2.5 cm, 5–10 cm to the side of each row. Maximum 1 application/yr. 24-hr re-entry interval.
			200 mL	81 mL	7	**Foliar application.** Do not make a foliar application following a soil application. Maximum 2 applications/yr. 24-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	0	Use higher rates for high pest populations or dense foliage. 12-hr re-entry interval.
tetronic and tetramic acid derivative (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	1	**Do not apply to bok choy, napa or mustard spinach.** Most effective on young stages of pest development. Slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
organophosphate (group 1B)	acephate	Orthene 75 SP	563–825 g	228–334 g	28	**Brussels sprouts, cabbage and cauliflower.** 12-hr re-entry interval.
	dimethoate	Cygon 480	0.7–1.0 L	0.28–0.4 L	4	**Broccoli and cauliflower.**
					7	**Kale.** Low rate only.
					21	**Brussels sprouts.** Use low rate on Brussels sprouts.
			0.6–1.0L	0.24–0.4 L	7	**Chinese broccoli and bok choy.**
		Lagon 480	0.7–1.0 L	0.28–0.4 L	4	**Broccoli and cauliflower.**
					21	**Brussels sprouts.**
			0.6–1.0 L	0.24–0.4 L	7	**Chinese broccoli and bok choy.**
	methamidophos	Monitor 480[2]	1.1–2.25 L	0.4–0.9 L	7	**Cabbage and cauliflower.**
					14	**Broccoli and Brussels sprouts.**
	naled	Dibrom	1.1 L	0.4 L	4	**Broccoli, Brussels sprouts, cabbage and cauliflower.** 48-hr re-entry interval.
neonicotinoid/ pyrethroid (group 4A/3A)	imidacloprid/ deltamethrin	Concept	650 mL	263 mL	7	See label for complete list of all brassica crops, including specialty brassica. Apply once the target pest has reached economic threshold according to local recommendations. 24-hr re-entry interval. 2-day re-entry interval for irrigation, topping, tying, thinning or hand pruning.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Do not use on muck soils.

Table 3-17. Brassica Crop Aphids, Cutworms and Slugs Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS						
pyrethroid (group 3A)	cypermethrin[3]	Ripcord 400 EC[3]	175 mL	71 mL	21	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Do not disturb soil for 5 days after application.
	permethrin	Pounce 384EC Perm-UP	180–390 mL	73–158 mL		**Broccoli, Brussels sprouts, cabbage and cauliflower.** Use high rate on dry soils or large larvae. Apply up to 5-leaf stage. Do not disturb ground for 5 days following application. 12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	3	**Black cutworm only.** See label for complete list of all brassica crops, including specialty brassicas. For optimum control, apply with modified seed oil adjuvant (Hasten or MSO). Apply to small plants, when no rain is forecast in next 24 hr. 12-hr re-entry interval.
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E Pyrinex 480 EC Nufos 4E	1.2–2.4 L	0.5–1 L	32	**Broccoli, Brussels sprouts, cabbage, cauliflower and Chinese cabbage.** Apply at 2–5-leaf stage. 24-hr re-entry interval. 10-day re-entry interval for cauliflower.
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10–20 kg	0	Use high rates on heavy infestations or after heavy rains.
carbamate (group 1A)	methomyl	Lannate TNG	775 g	314 g	30	**Brussels sprouts only.** 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Do not use on muck soils.

Table 3-18. Brassica Crop Cabbage Maggot Control

Group Name (Group #)	Common Name	Trade Name	Rate	PHI[1]	Notes
Planting-Water Treatment					
organophosphate (group 1B)	chlorpyrifos	Lorsban 50W	32.5 g/ 100 L of water Apply 200 mL/plant.	32	**Cabbage only.** Do not use with starter fertilizers. 24-hr re-entry interval.
Treatment After Planting					
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E[2] Nufos 4E[2]	210 mL/ 1,000 m of row	32	**Broccoli, Brussels sprouts, cabbage, cauliflower and Chinese cabbage.** 24-hr re-entry interval. 10-day re-entry interval for cauliflower.
				15	**Pak choy.** 24-hr re-entry interval.
			150 mL/ 1,000 m of row	21	**Chinese broccoli.** Apply 5–7 days after seeding. 24-hr re-entry interval.
		Pyrinex 480 EC	150 mL/ 1,000 m of row	21	**Chinese broccoli.** Apply 5–7 days after seeding. 24-hr re-entry interval.
		Lorsban 15G Pyrifos 15G	0.6–1.0 kg/ 1,000 m of row	32	**Direct-seeded cabbage, cauliflower, broccoli, and Brussels sprouts.** 24-hr re-entry interval. 10-day re-entry interval for cauliflower.

[1] PHI = Pre-Harvest Interval (days).
[2] Apply in a 10-cm band on each side of the plant 3 days after transplanting or 7–10 days after direct seeding.

Table 3–19. Brassica Crop Flea Beetles and Thrips Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
FLEA BEETLES						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC Silencer 120 EC	42 mL	17 mL	1	**Cabbage.** 24-hr re-entry interval.
					3	**Broccoli, Brussels sprouts and cauliflower.** 24-hr re-entry interval.
	cypermethrin	Ripcord 400 EC	87.5–125 mL	35–51 mL	3	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Do not graze or feed treated foliage to livestock. Do not apply to muck soils.
	deltamethrin	Decis 5 EC	150–200 mL	61–81 mL	3	**Cabbage.**
	permethrin	Pounce 384EC Perm-UP	180 mL	73 mL	2	**Horseradish.** 12-hr re-entry interval.
			90–180 mL	36–73 mL	3	**Brussels sprouts, cabbage and cauliflower.** 12-hr re-entry interval.
					7	**Broccoli.** 12-hr re-entry interval.
		Ambush 500EC	140 mL	57 mL	2	**Horseradish.** 12-hr re-entry interval.
			70–140 mL	28–57 mL	3	**Brussels sprouts, cabbage and cauliflower.** 12-hr re-entry interval.
					7	**Broccoli.** 12-hr re-entry interval.
neonicotinoid/ pyrethroid (group 4A/3A)	imidacloprid/ deltamethrin	Concept	650 mL	263 mL	7	See label for complete list of all brassica crops, including specialty brassica. Apply once the target pest has reached economic threshold according to local recommendations. 24-hr re-entry interval. 2-day re-entry interval for irrigation, topping, tying, thinning or hand pruning.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	1.5–2.0 L	0.6–0.8 L	7	**Broccoli, Brussels sprouts, cabbage and cauliflower.** 4-day re-entry interval.
		Thionex 50 WP[2]	1.1–1.75 kg	0.4–0.7 kg	9	**Broccoli, Brussels sprouts, cabbage and cauliflower.** 9-day re-entry interval.
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1 L	3	**Cabbage and cauliflower.**
					5	**Broccoli, Brussels sprouts and kohlrabi.**
					7	**Horseradish.**
					21	**Chinese cabbage, kale and mustard greens.**
THRIPS						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	87.5–125 mL	35–51 mL	3	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Do not graze or feed treated foliage to livestock. Do not apply to muck soils.
		UP-Cyde 2.5 EC	200 mL	81 mL	3	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Use with Agral 90 (0.03% v/v). Do not apply to muck soils. 12-hr re-entry interval.
spinosyn (group 5)	spinosad	Success 480 SC	146 mL	59 mL	3	**Suppression only.** See label for complete list of all brassica crops, including specialty brassicas. Re-entry permitted when residues are dry. 3-day re-entry interval for hand harvesting, irrigating, pruning, topping, thinning or tying activities.
		Entrust 80 W	87.5 g	35.4 g	3	

[1] PHI = Pre-Harvest Interval (days).
[2] Last date of use is December 31, 2012.

Table 3-20. Brassica Crop Imported Cabbageworm, Cabbage Looper, Diamondback Moth Caterpillar Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
biological (group 11)	*Bacillus thuringiensis*	Dipel 2X DF	55–550 g	22–223 g	0	See the label for a complete list of all brassica crops, including specialty brassicas. Use 275–550 g/ha (111–223 g/acre) for loopers.
			275–550 g	111–223 g	0	**Mustard greens. Cabbage loopers.**
		Thuricide-HPC	2.0–4.25 L	0.8–1.7 L	0	See the label for a complete list of all brassica crops, including specialty brassicas. Use higher rates for looper control, heavy infestations or when foliage is dense.
		Bioprotec CAF	1.4–2.8 L	0.56–1.1 L	0	
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	74 mL	3	See the label for a complete list of all brassica crops, including specialty brassicas. Maintain a spray pH of 6 or higher. Re-entry permitted when residues are dry. 3-day re-entry interval for hand harvesting, irrigating, pruning, topping, thinning or tying activities.
		Entrust 80 W	109 g	44 g	3	
	spinetoram	Delegate WG	140–200 g	57–81 g	1	Use the higher rate for high infestations or advanced growth stages of the target pest. 12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	3	12-hr re-entry interval.
benzoylureas (group 15)	novaluron	Rimon 10 EC	410–820 mL in 200–400 L water	166–332 mL in 18–36 gal water	2–4	**Broccoli, Chinese broccoli, Brussels sprouts, cabbage, Chinese cabbage, gai choy, cauliflower, Cavalo broccoli and kohlrabi.** 12-hr re-entry interval.
					7	**Leafy brassica greens.** See the label for a complete list of all brassica crops, including specialty brassicas. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] The carbamates and the pyrethroids have provided inconsistent control in some areas.
[3] Last date of use is December 31, 2012.

Table 3-20. Brassica Crop Imported Cabbageworm, Cabbage Looper, Diamondback Moth Caterpillar Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
pyrethroid[2] (group 3A)	deltamethrin	Decis 5 EC	150–200 mL	61–81 mL	1	**Brussels sprouts.**
					3	**Broccoli, cabbage and cauliflower.**
			200 mL	81 mL	5	**Kale.**
	lambda-cyhalothrin	Matador 120EC Silencer 120 EC	42 mL	17 mL	1	**Cabbage.** Imported cabbageworm and diamondback moth larvae. 24-hr re-entry interval.
					3	**Broccoli, Brussels sprouts and cauliflower.** Imported cabbageworm and diamondback moth larvae. 24-hr re-entry interval.
			83 mL	34 mL	1	**Cabbage.** Cabbage looper. 24-hr re-entry interval.
					3	**Broccoli, Brussels sprouts and cauliflower.** Cabbage looper. 24-hr re-entry interval.
	cypermethrin	Ripcord 400 EC	87.5–125 mL	35–51 mL	3	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Do not apply to muck soils. Do not graze or feed treated foliage to livestock.
		UP-Cyde 2.5 EC	140 mL	57 mL	3	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Add Agral 90 at (0.03% v/v). Do not apply to muck soils. Maximum of 3 applications/yr at 2-week intervals. 12-hr re-entry interval.
	permethrin	Pounce 384EC	90–180 mL	36–73 mL	3	**Brussels sprouts, cabbage, and cauliflower.** 12-hr re-entry interval.
					7	**Broccoli and Chinese broccoli.** 12-hr re-entry interval.
			180 mL	73 mL	3	**Pak choy and Chinese cabbage.** 12-hr re-entry interval.
		Perm-UP	90–180 mL	36–73 mL	3	**Brussels sprouts, cabbage, and cauliflower.** Add Agral 90 (0.03% v/v) to improve wetting and coverage. 12-hr re-entry interval.
					7	**Broccoli and Chinese broccoli.** Add Agral 90 (0.03% v/v) to improve wetting and coverage. 12-hr re-entry interval.
			180 mL	73 mL	3	**Pak choy and Chinese cabbage.** Add Agral 90 (0.03% v/v) to improve wetting and coverage. 12-hr re-entry interval.
		Ambush 500EC	70–140 mL	28–57 mL	3	**Brussels sprouts, cabbage and cauliflower.** 12-hr re-entry interval.
					7	**Broccoli.** 12-hr re-entry interval.
			140 mL	57 mL	3	**Chinese cabbage and pak choy.** 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] The carbamates and the pyrethroids have provided inconsistent control in some areas.
[3] Last date of use is December 31, 2012.

Table 3-20. Brassica Crop Imported Cabbageworm, Cabbage Looper, Diamondback Moth Caterpillar Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
neonicotinoid/ pyrethroid (group 4A/3A)	imidacloprid/ deltamethrin	Concept	650 mL	263 mL	7	See label for complete list of all brassica crops, including specialty brassica. Apply once the target pest has reached economic threshold according to local recommendations. 24-hr re-entry interval. 2-day re-entry interval for irrigation, topping, tying, thinning or hand pruning.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 50 WP[3]	1–1.75 kg	0.4–0.71 kg	9	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Use high rate on loopers. 9-day re-entry interval.
		Thiodan 4EC[3]	1.5–2 L	0.6–0.8 L	7	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Use high rate on loopers. 4-day re-entry interval.
carbamate[2] (group 1A)	methomyl[2]	Lannate TNG	270–540 g	109–219 g	1	**Cabbage.** 12-hr re-entry interval. 48-hr re-entry interval for hand pruning/harvesting.
					7	**Broccoli, Brussels sprouts and cauliflower.** 12-hr re-entry interval. 48-hr re-entry interval for hand pruning/harvesting.
	carbaryl	Sevin XLR	2.5–5.25 L	1–2.1 L	3	**Cabbage and cauliflower.**
					5	**Broccoli, Brussels sprouts and kohlrabi.**
					7	**Horseradish.**
					21	**Chinese cabbage, kale and mustard greens.**
organophosphate (group 1B)	acephate	Orthene 75 SP	563–825 g	228–334 g	28	**Brussels sprouts, cabbage and cauliflower.** 12-hr re-entry interval.
	naled	Dibrom	1.1–2.2 L	0.4–0.9 L	4	**Broccoli, Brussels sprouts, cabbage and cauliflower.** Use high rate for loopers only. 48-hr re-entry interval.
	methamidophos	Monitor 480[3]	1.1–2.25 L	0.4–0.91 L	7	**Cabbage and cauliflower.**
					14	**Broccoli and Brussels sprouts.** Use high rate on cabbage loopers.

[1] PHI = Pre-Harvest Interval (days).
[2] The carbamates and the pyrethroids have provided inconsistent control in some areas.
[3] Last date of use is December 31, 2012.

Table 3–21. Brassica Crop Swede Midge and Pea Leafminer Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
SWEDE MIDGE						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC Silencer 120 EC	83 mL	34 mL	1	**Cabbage.** 24-hr re-entry interval.
					3	**Broccoli, Brussels sprouts and cauliflower.** 24-hr re-entry interval.
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	86 g	35 g	7	See the label for a complete list of all brassica crops, including specialty brassicas. Alternate sprays with other insecticide families. 48-hr re-entry interval for scouting. 4-day re-entry interval for all other post-application activities.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	3	See the label for a complete list of all brassica crops, including specialty brassicas. For optimum control, apply with modified see oil adjuvant (Hasten or MSO). 12-hr re-entry interval.
tetronic and tetramic acid derivative (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–147 mL	1	**Do not apply to bok choy, napa or mustard spinach.** See label for complete list of all brassica crops, including specialty brassicas. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. Use high rate when pest pressure is high. 12-hr re-entry interval.
spinosyn (group 5)	spinosad	Entrust 80 W	87.5 g	35 g	3	**Reduction in damage.** See the label for a complete list of all brassica crops, including specialty brassicas. Re-entry permitted when residues are dry. 3-day re-entry interval for hand harvesting, irrigating, pruning, topping, thinning or tying activities.
PEA LEAFMINER						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	86 g	35 g	7	See the label for a complete list of all brassica crops, including specialty brassicas. Alternate sprays with other insecticide families. 48-hr re-entry interval for scouting. 4-day re-entry interval for all other post-application activities.
cyromazine (group 17)	cyromazine	Citation 75WP	188 g in 200 L water	76 g in 20 gal water	7	**Leafy brassica greens only.** 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

CARROTS

Seed treatments registered on carrot are listed in Table 3–22, *Carrot Seed Treatments*. Activities of products for carrot diseases are listed in Table 3–23, *Activity of Fungicides on Carrot Diseases*. Products registered for carrot diseases are listed in Table 3–24, *Carrot Disease Control*.

Activities of products for carrot insects are listed in Table 3–25, *Activity of Insecticides on Carrot Insects*. Products registered for carrot insects are listed in Table 3–26, *Carrot Insect Control*.

Table 3–22. Carrot Seed Treatments

Trade Name	Active Ingredient	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	**For use in commercial seed-treatment plants only. Export use only.**
Thiram 75 WP	thiram	90 g/ 25 kg seed	damping-off	Seed box treatment.
Rovral	iprodione	521 mL/ 100 kg seed	seed-borne alternaria	**For imported seed only.**
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping-off (*Rhizoctonia solani*)	**For import use only. Not for domestic commercial or on-farm seed treatment.**

Table 3–23. Activity of Fungicides on Carrot Diseases

Common Name	Trade Name	Alternaria Leaf Blight	Cercospora Leaf Blight	*Pythium* spp.	Rhizoctonia Crown/ Root Rot	Sclerotinia White Rot	Botrytis Grey Mould
chlorothalonil	Bravo 500	✔	✔				
	Echo 90DF	✔	✔				
mancozeb	Manzate Pro-Stick	✔	✔				
	Dithane DG Rainshield	✔	✔				
	Penncozeb 80WP	✔	✔				
metiram	Polyram DF	✔	✔				
pyraclostrobin/ boscalid	Pristine WG	✔					
pyraclostrobin	Cabrio EG	✔	✔				
boscalid	Lance WDG/ Cantus WDG	✔					
cyprodinil/fludioxonil	Switch 62.5 WG	✔					✔
fluazinam	Allegro 500F	✔				✔	
metalaxyl	Ridomil Gold 1G			✔[1]			
cyazofamid	Ranman 400SC			+[2]			
azoxystrobin	Quadris Flowable				✔		
Coniothyrium minitans	Contans WG					+	
Bacillus subtilis	Serenade ASO					+	

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

[1] Cavity spot.
[2] Cavity spot, root dieback/forking.

Table 3-24. Carrot Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
LEAF BLIGHT						
chloronitrile (group M5)	chlorothalonil	Bravo 500	2.4–3.2 L	1.0–1.3 L	1	48-hr re-entry interval.
		Echo 90DF	1.3–1.8 kg	0.53–0.73 kg		
dithiocarbamate (group M3)	mancozeb	Manzate Pro-Stick	2.25 kg	0.9 kg	7	Do not feed treated tops to livestock. 24-hr re-entry interval.
		Dithane DG Rainshield				
		Penncozeb 80WP				
	metiram	Polyram DF	2.25 kg	0.9 kg	7	Do not feed treated tops to livestock.
SDHI/QoI (group 7/11)	pyraclostrobin/ boscalid	Pristine WG	580–735 g	234–297 g	0	Do not make sequential applications. Use high rate under heavy disease pressure. 3-day re-entry interval for thinning or hand harvest.
QoI (group 11)	pyraclostrobin	Cabrio EG	0.56–1.1 kg	0.23–0.44 kg	3	**Alternaria leaf blight.** Maximum 2 sequential applications. 12-hr re-entry interval. 3-day re-entry interval (hand-harvesting).
			0.56–0.84 kg	0.23–0.34 kg	3	**Cercospora leaf blight.** Maximum 2 sequential applications. 12-hr re-entry interval. 3-day re-entry interval (hand-harvesting).
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	315 g	127 g	0	**Alternaria leaf blight.** Maximum 2 sequential applications. 12-hr re-entry interval.
phenylpyrroles/ anilino-pyramidines (group 12/9)	cyprodonil/ fludioxonil	Switch 62.5 WG	775–975 g in a minimum of 200 L water	314–395 g in a minimum of 20 gal water	7	**Alternaria leaf blight and botrytis grey mould.** Maximum 2 sequential applications. Use high rate under high disease pressure. 12-hr re-entry interval.
2,6-dinitroanilines (group 29)	fluazinam	Allegro 500F	1.16 L	0.47 L	7	**Alternaria leaf blight.** 24-hr re-entry interval.
CAVITY SPOT						
phenylamides (group 4)	metalaxyl	Ridomil Gold 1G	25 kg/ treated hectare	10 kg/ treated acre		Treatment rate varies with bed and planting shoe width. Please consult label for calculations. Apply product evenly with seed in the furrow. 12-hr re-entry interval.
QiI (group 21)	cyazofamid	Ranman 400SC	0.44 L	0.18 L	30	Post-plant, pre-emergent application. Apply to soil 3 days after planting. 12-hr re-entry interval.
CROWN ROT/VIOLET ROOT ROT						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	40	Apply in-furrow at seeding or as one banded application over the row after emergence.

[1] PHI = Pre-Harvest Interval (days).

Table 3-24. Carrot Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
SCLEROTINIA WHITE ROT						
2,6-dinitroanilines (group 29)	fluazinam	Allegro 500F	1.16 L	0.47 L	7	24-hr re-entry interval.
microbial (group 44)	*Coniothyrium minitans*	Contans WG	2–4 kg	0.8–1.6 kg		**Suppression only.** Broadcast application, lightly incorporated. Apply to soil prior to or at planting at least 3 months prior to typical onset of disease. Regular use of Contans WG in successive years within a long-term management strategy will improve disease control. If incorporation will displace soil greater than 5 cm, increase application rate to 3–6 kg/ha (1.2–2.4 kg/acre).
	Bacillus subtilis	Serenade ASO	8–15 L	3–6 L		**Suppression only.** Begin application soon after emergence.

[1] PHI = Pre-Harvest Interval (days).

Table 3-25. Activity of Insecticides on Carrot Insects

Common Name	Trade Name	Aster Leafhopper	Carrot Weevil	Carrot Rust Fly	Cutworms	Aphids
carbaryl	Sevin XLR	✔				
kaolin clay	Surround WP	–				
phosmet	Imidan 50-WP		✔			
lambda-cyhalothrin	Matador 120EC		✔	✔		
	Silencer 120 EC		✔	✔		
cypermethrin	Ripcord 400 EC			✔	✔	
	UP-Cyde 2.5 EC			✔		
diazinon	Diazinon 50 W			✔		✔
permethrin	Pounce 384EC				✔	
	Perm-UP				✔	
	Ambush 500EC				✔	
chlorpyrifos	Lorsban 4E				✔	
	Pyrinex 480 EC				✔	
	Nufos 4E				✔	
flonicamid	Beleaf 50SG					✔

✔ = control
– = reduction in damage
blank cell = not registered for control of this pest

Table 3-26. Carrot Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ASTER LEAFHOPPER						
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1 L	1	Use low rate on young plants. Do not graze livestock on carrot tops for 24 hr after treatment.
Not Classified	kaolin clay	Surround WP	12.5–25 kg in 500 L water	5–10 kg in 45 gal water	0	For early applications, use the higher rate per 500 L water.
CARROT WEEVIL						
organophosphate (group 1B)	phosmet	Imidan 50-WP	2.25 kg	0.9 kg	40	5-day restricted entry interval. See label for re-entry information.
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	14	Make first application at 2–3-leaf stage when insects or damage appear. 24-hr re-entry interval.
		Silencer 120 EC			7	
CARROT RUST FLY						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	175 mL in 550 L water	71 mL in 55 gal water	35	Do not graze livestock on treated carrot tops.
		UP-Cyde 2.5 EC	280 mL in 550 L water	113 mL in 55 gal water	35	12-hr re-entry interval.
	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	14	Make first application at 2–3-leaf stage when insects or damage appear. 24-hr re-entry interval.
		Silencer 120 EC			7	
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1 kg	0.4 kg	10	
CUTWORMS[2]						
pyrethroid (group 3A)	permethrin	Pounce 384EC	180–390 mL	73–158 mL		Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. Use high rate on large larvae, dry soils or muck soils. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL		
	cypermethrin	Ripcord 400 EC	175 mL	71 mL	21	Do not disturb soil for 5 days after application. Do not graze livestock on treated carrot tops.
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	2.4–4.8 L	0.9–1.9 L	60	Use high rate on large larvae or dry soils. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				

[1] PHI = Pre-Harvest Interval (days).
[2] Seedling treatments.

CELERY

Seed treatments and transplant disease treatments registered on celery diseases are listed in Table 3–27, *Celery Seed Treatments and Transplant Disease Control.* Products registered for celery diseases are listed in Table 3–28, *Celery Disease Control.*

Activities of products for celery insects are listed in Table 3–29, *Activity of Insecticides on Celery Insects.* Products registered for celery insects are listed in Table 3–30, *Celery Aphid Control* and Table 3–31, *Celery Insect Control.*

Table 3–27. Celery Seed Treatments and Transplant Disease Co[illegible]l

Group Name (Group #)	Common Name	Trade Name	Rate	Notes
DAMPING-OFF, FUNGUS ROOT ROT				
Seed Treatments				
dithiocarbamate (group M3)	thiram	Thiram 75 WP	90 g/ 25 kg of seed	Seed box treatment.
QoI (group 11)	azoxystrobin	Dynasty 100FS	25–50 mL/ 100 kg of seed	**For import use only.** Not for domestic commercial or on-farm seed treatment.
Greenhouse Treatments				
phthalamide (group M4)	captan	Maestro 80DF	1.25 kg/ 1,000 L of water Apply 50–85 L of solution per 100 m^2	48-hr re-entry interval.

Table 3–28. Celery Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CELERY BLIGHT						
chloronitrile (group M5)	chlorothalonil	Bravo 500	1.6–2.4 L	0.6–0.9 L	7	**Early blight.** Apply on a 3–5-day schedule. 48-hr re-entry interval.
			2.4–4.0 L	0.9–1.6 L	7	**Late blight.** Apply on an 8–10-day schedule. 48-hr re-entry interval.
		Echo 90DF	0.9–1.3 kg	0.4–0.5 kg	7	**Early blight.** Apply on 3–5-day schedule. 48-hr re-entry interval.
			1.3–2.3 kg	0.5–0.9 kg	7	**Late blight.** Apply on 8–10-day schedule. 48-hr re-entry interval.
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	2.25 kg	0.9 kg	14	Wash and trim. 24-hr re-entry interval.
		Penncozeb 80WP				
		Manzate Pro-Stick	2.25–3.25 kg	0.9–1.3 kg		
	metiram	Polyram DF	2.25–3.25 kg	0.9–1.3 kg	14	**After transplanting only.** Use higher rate during periods of rain or heavy dew.
inorganic (group M1)	copper sulfate	Copper 53W	3.8 kg	1.5 kg	1	48-hr re-entry interval.
	copper oxychloride	Copper Spray	4.0 kg in 1,000 L water	1.6 kg in 90 gal water	1	
SDHI/QoI (group 7/11)	pyraclostrobin/ boscalid	Pristine WG	1 kg	0.4 kg	0	**Suppression of early and late blight.** Maximum 2 applications/yr (late blight) or 1 application/yr (early blight). 24-hr re-entry interval for most activities. 9-day for hand-harvesting and thinning.
PINK ROT (SCLEROTINIA)						
microbial (group 44)	*Coniothyrium minitans*	Contans WG	2–4 kg	0.8–1.6 kg		**Suppression.** Broadcast application, lightly incorporated. Apply to soil prior to or at planting or at time of transplant at least 3 months prior to typical onset of disease. Regular use of Contans WG in successive years within a long-term management strategy will improve disease control. If incorporation will displace soil greater than 5 cm, increase application rate to 3–6 kg/ha (1.2–2.4 kg/ha).
	Bacillus subtilis	Serenade Max	3–6 kg	1.2–2.4 kg	0	**Suppression.** Make the first application approximately 8 weeks before harvest and repeat in 14-day intervals. Apply in sufficient water to ensure thorough coverage to the base of the plants.

[1] PHI = Pre-Harvest Interval (days).

Table 3-29. Activity of Insecticides on Celery Insects

Common Name	Trade Name	Aphids	Aster Leafhopper	Carrot Weevil	Tarnished Plant Bug	Cabbage Looper	Cutworms	Leafminers
acetamiprid	Assail 70 WP	✔						–
imidacloprid	Admire 240 F	✔						
thiamethoxam	Actara 25WG	✔			–			
spirotetramat	Movento 240 SC	✔						
endosulfan	Thionex 50 WP	✔				✔		
	Thiodan 50 WP	✔			✔	✔		
	Thiodan 4EC	✔			✔	✔		
naled	Dibrom	✔				✔		
acephate	Orthene 75 SP	✔			✔			
flonicamid	Beleaf 50SG	✔						
cypermethrin	Ripcord 400 EC		✔					
carbaryl	Sevin XLR		✔					
malathion	Malathion 85E	✔	✔					
kaolin clay	Surround WP		–					
phosmet	Imidan 50-WP			✔				
Bacillus thuringiensis	Thuricide-HPC					✔		
	Bioprotec CAF					✔		
spinosad	Success 480 SC					✔		
	Entrust 80 W					✔		
spinetoram	Delegate WG					✔		
chlorantraniliprole	Coragen					✔	✔	✔
chlorpyrifos	Lorsban 4E						✔	
	Pyrinex 480 EC						✔	
	Nufos 4E						✔	
cyromazine	Citation 75WP							✔
abamectin	Agri-mek 1.9% EC							✔

✔ = control
– = reduction in damage
blank cell = not registered for control of this pest

Table 3–30. Celery Aphid Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	Alternate applications with other insecticide families. 12-hr re-entry interval.
	imidacloprid	Admire 240 F	0.73–1.3 L	0.3–0.5 L	45	Soil application. 24-hr re-entry interval.
	thiamethoxam	Actara 25WG	105 g	42 g	7	Apply in sufficient water volume to ensure adequate coverage. Use at least 100 L per hectare. 12-hr re-entry interval.
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	3	Most effective on young stages of pest development. Slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thionex 50 WP[4]	1.75 kg	0.7 kg	17	Trim the celery of all outer leaves. 4-day re-entry interval.
		Thiodan 50 WP[2]				
		Thiodan 4EC[3]	2 L	0.8 L	14	
organophosphate (group 1B)	naled	Dibrom	1.1–1.65 L in 100–300 L water	0.4–0.67 L in 9–27 gal water	4	48-hr re-entry interval.
	acephate	Orthene 75 SP	563–825 g	228–334 g	21	**Green peach aphid only.** 24-hr re-entry interval. Workers in the fields must wear gloves for 2 weeks following application.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	48–65 g	0	Thorough spray coverage is essential for optimum control. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Registration expires on December 31, 2013.
[4] Registration expires on July 1, 2013.

Table 3-31 Celery Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ASTER LEAFHOPPER						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	86 mL	35 mL	7	
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1 L	5	
organophosphate (group 1B)	malathion	Malathion 85E	1,100 mL	445 mL	7	
Not Classified	kaolin clay	Surround WP	12.5–25 kg in 500 L water	5–10 kg in 45 gal water	0	For early applications, use the higher rate in 500 L water.
CARROT WEEVIL						
organophosphate (group 1B)	phosmet	Imidan 50-WP	2.25 kg	0.9 kg	40	5-day re-entry interval. See label for re-entry information.
TARNISHED PLANT BUG						
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 50 WP[2]	1.75 kg	0.7 kg	17	Trim the celery of all outer leaves. 4-day re-entry interval.
		Thiodan 4EC[3]	2.0 L	0.8 L	14	
organophosphate (group 1B)	acephate	Orthene 75 SP	563–825 g	228–334 g	21	24-hr re-entry interval. Workers must wear gloves in the field for 2 weeks following application.
neonicotinoid (group 4A)	thiamethoxam	Actara 25WG	210 g	85 g	7	**Reduction in damage.** Apply in sufficient water volume to ensure adequate coverage. Use at least 100 L per hectare. 12-hr re-entry interval.
CABBAGE LOOPER						
biological (group 11)	*Bacillus thuringiensis*	Thuricide-HPC	2.0–4.25 L	0.8–1.7 L	0	
		Bioprotec CAF	1.4–2.8 L	0.6–1.1 L	0	
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	74 mL	1	
		Entrust 80 W	109 g	44 g	1	
	spinetoram	Delegate WG	140–200 g	57–81 g	1	12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 50 WP[2]	1.75 kg	0.7 kg	17	Trim the celery of all outer leaves. 4-day re-entry interval.
		Thionex 50 WP[5]				
		Thiodan 4EC[3]	2 L	0.8 L	14	
organophosphate (group 1B)	naled	Dibrom	1.1–1.65 L in 100–300 L water	0.4–0.67 L in 9–27 gal water	4	48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Registration expires on December 31, 2013.
[4] Seedling treatments.
[5] Registration expires on July 1, 2013.

Table 3-31. Celery Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS[4]						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.5–1 L	70	Use high rate on large larvae or dry soils. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	**Black cutworm.** Apply to small plants, when no rain is forecast in next 24 hr. 12-hr re-entry interval.
LEAFMINERS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	86 g	35 g	7	**Pea leafminer only.** Alternative applications with other insecticide families. 12-hr re-entry interval.
cyromazine (group 17)	cyromazine	Citation 75WP	188 g	76 g	7	Apply when leafminer larvae first appear. 12-hr re-entry interval.
avermectins (group 6)	abamectin	Agri-mek 1.9% EC	0.6–1.1 L	243–445 mL	14	Use lower rate under low pest pressure.
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Vegetable and serpentine leafminers only. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Registration expires on December 31, 2013.
[4] Seedling treatments.
[5] Registration expires on July 1, 2013.

CUCURBITS

cucumber, muskmelon, watermelon, pumpkin, squash, gourds (also known as vine crops)

Seed and planting treatments registered on cucurbits are listed in Table 3–32, *Cucurbit Seed and Planting Treatments.* Activities of products for cucurbit diseases are listed in Table 3–33, *Activity of Fungicides on Cucurbit Diseases.* Products registered for cucurbit diseases are listed in Table 3–34, *Cucurbit Downy Mildew Fungicides* and Table 3–35, *Cucurbit Disease Control.*

Activities of products for cucurbit insects are listed in Table 3–36, *Activity of Insecticides on Cucurbit Insects.* Products registered for cucurbit insects are listed in Table 3–37, *Cucurbit Insect Control.*

Table 3–32. Cucurbit Seed and Planting Treatments

Active Ingredients	Trade Name	Rate	Fusarium	Rhizoctonia	Pythium	Notes
fludioxonil	Maxim 480FS	5.2–10.4 mL/ 100 kg seed	✔	✔		May be tank-mixed with Apron XL LS.
metalaxyl-M	Apron XL LS	20–40 mL/ 100 kg seed			✔	**For use on imported seed only.** Do not treat seeds in Canada. May be tank-mixed with Maxim 480FS.
	Ridomil Gold 480SL	2.25–4.5 mL/ 100 m row			✔	**Cucumbers only.** Apply as an 18-cm band centered over the row immediately after seeding or before transplanting. 12-hr re-entry interval.
azoxystrobin	Dynasty 100FS	25–50 mL/ 100 kg seed		✔		**For import use only.** Not for domestic, commercial or on-farm treatment.
thiram	Thiram 75 WP	50 g/ 25 kg seed	✔	✔	✔	
Trichoderma harzianum	RootShield Granules	600–750 g/m^3 soil or planting mix	+	+	+	4-hr re-entry interval.

✔ = control
+ = suppression
blank cell = not registered for control of this pest

Table 3–33. Activity of Fungicides on Cucurbit Diseases
For information on seed decay and root rots, see Table 3–32, *Cucurbit Seed and Planting Treatments*, opposite page.

Common Name	Trade Name	Downy Mildew	Powdery Mildew	Angular Leaf Spot	Scab	Anthracnose	Alternaria	Gummy Stem Blight/ Black Rot
chlorothalonil	Bravo 500	+	✔		✔	✔	*	*
	Echo 720		✔		✔	✔	*	*
mancozeb	Dithane DG	+			✔	✔	✔	✔
	Manzate Pro-Stick	+			✔	✔	✔	✔
	Penncozeb 80WP	+			✔	✔	✔	✔
cyazofamid	Ranman 400SC	✔						
propamocarb/ chlorothalonil	Tattoo C	✔						
fluopicolide + chlorothalonil	Presidio Fungicide + Bravo	✔	✔		✔	✔	*	*
copper sulphate	Copper 53W			✔		+		
copper oxychloride	Copper Spray			✔		+		
copper hydroxide	Parasol WG			✔				
	Coppercide WP			✔				
pyraclostrobin	Cabrio EG	(✔)	✔			✔	✔	✔
difenoconazole	Inspire		✔					+
quinoxyfen	Quintec		✔					
potassium bicarbonate	MilStop		+					
boscalid	Lance WDG/ Cantus WDG						✔	✔
captan	Maestro 80DF				✔	✔		
	Supra Captan 80 WDG				✔	✔		
mandipropamid	Revus	+						
fenamidone	Reason	(✔)						
Bacillis subtilis	Serenade ASO	+	✔					
folpet	Folpan 80 WDG					✔		

✔ = control
\+ = suppression
(✔) = registered but not considered effective or resistance is documented
* = some control of this pest may be expected when the product is used to control labelled pests
blank cell = not registered for control of this pest

Table 3–34. Cucurbit Downy Mildew Fungicides

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
Broadspectrum Preventative Fungicides Begin applications no later than vine development.						
chloronitrile (group M5)	chlorothalonil	Bravo 500	4.8 L	1.9 L	1	48-hr re-entry interval.
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	1.1–3.25 kg	0.4–1.3 kg	14	24-hr re-entry interval.
		Penncozeb 80WP				
		Manzate Pro-Stick	2.25–3.25 kg	0.9–1.3 kg		
Downy Mildew–Targeted Preventative Fungicides Begin applications when weather conditions favour downy mildew or if downy mildew is identified anywhere in the Great Lakes region.						
QiI (group 21)	cyazofamid	Ranman 400SC	150–200 mL	61–81 mL	1	Do not make sequential applications. 30-day plant back interval. Tank-mix with an NIS or Organosilicone surfactant. 12-hr re-entry interval.
carbamate/ chloronitrile (group 28/M5)	propamocarb/ chlorothalonil	Tattoo C	1.8–2.7 L	0.7–1.1 L	2	Do not make sequential applications. 48-hr re-entry interval.
benzamides + chloronitrile (group 43+M5)	fluopicolide + chlorothalonil	Presidio + Bravo 500	220–292 mL + 4.8 L	89–118 mL + 1.9 L	2	See label for rotational restrictions. Also provides suppression of phytophthora blight. 48-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	5–15 L	2–6 L	0	**Suppression only.** Begin applications soon after emergence or transplanting.

[1] PHI = Pre-Harvest Interval (days).

Table 3-35. Cucurbit Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ANGULAR LEAF SPOT						
inorganic (group M1)	copper sulfate	Copper 53W	2.5–3 kg	1–1.2 kg	1	48-hr re-entry interval.
	copper hydroxide	Parasol WG	2.25–3.25 kg	0.9–1.3 kg	1	**Cucumbers only.** 48-hr re-entry interval.
		Coppercide WP				
	copper oxychloride	Copper Spray	4 kg	1.6 kg	1	
POWDERY MILDEW						
chloronitrile (group M5)	chlorothalonil	Bravo 500	4.8 L	1.9 L	1	48-hr re-entry interval.
		Echo 720	3.3 L	1.3 L		
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	3	Do not make more than 1 application before alternating with a different fungicide family. 12-hr re-entry interval.
aza-naphthalenes (group 13)	quinoxyfen	Quintec	300–440 mL	121–178 mL	3	**Melons, pumpkin and winter squash.** 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	512 mL	207 mL	0	Apply no more than 2 sequential applications. 12-hr re-entry interval.
Not Classified	potassium bicarbonate	MilStop	2.8–5.6 kg	1.1–2.27 kg	0	**Suppression only.** Ensure thorough spray coverage. 4-hr re-entry interval.
ALTERNARIA, ANTHRACNOSE, GUMMY STEM BLIGHT AND SCAB						
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	1.1–3.25 kg	0.4–1.3 kg	14	24-hr re-entry interval.
		Penncozeb 80WP				
		Manzate Pro-Stick	2.25–3.25 kg	0.9–1.3 kg		
chloronitrile (group M5)	chlorothalonil	Bravo 500	4.8 L	1.9 L	1	**Anthracnose and scab.** 48-hr re-entry interval.
		Echo 720	3.3 L	1.33 L		
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	3	**Alternaria, anthracnose and gummy stem blight.** Use high rate for gummy stem blight. Do not make more than 1 application before alternating with a different fungicide family. 24-hr re-entry interval.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	460 g	186 g	0	**Alternaria and gummy stem blight.** 12-hr re-entry interval.
phthalimide (group M4)	captan	Maestro 80DF	2.25–4.25 kg	0.9–1.7 kg	2	**Cucumber only. Anthracnose and scab.** Use low rate on young plants. Aerial applications permitted. 48-hr re-entry interval.
		Supra Captan 80 WDG				
	folpet	Folpan 80 WDG	2.5–5 kg	1–2 kg	1	**Anthracnose only.** 24-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

Table 3–36. Activity of Insecticides on Cucurbit Insects

Common Name	Trade Name	Slugs	Cucumber Beetles	Aphids	Two-Spotted Spider Mite	Cutworms
imidacloprid	Admire 240 F		✔			
	Grapple$_2$		✔			
endosulfan	Thionex 50 WP		✔	✔		
	Thiodan 4EC		✔	✔		
kaolin clay	Surround WP		✔			
spirotetramat	Movento 240 SC			✔		
flonicamid	Beleaf 50SG			✔		
malathion	Malathion 25W		✔	(✔)		
spiromesifen	Oberon				✔	
chlorpyrifos	Lorsban 4E					✔
	Pyrinex 480 EC					✔
	Nufos 4E					✔
carbaryl	Sevin XLR		✔			✔
chlorantraniliprole	Coragen					✔

✔ = control
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

Table 3-37. Cucurbit Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUCUMBER BEETLES AND APHIDS						
Planting Treatment						
neonicotinoid (group 4A)	imidacloprid	Admire 240 F	0.98 L/ha (183-cm row spacing)	0.36 L/ha (183-cm row spacing)	21	**Cucumber Beetle.** Apply 18 mL/100 m of row in-furrow at planting or banded soon after planting. Depending on the row spacing, apply 0.74–1.16 L/ha (299–470 mL/acre). See the product labels for details. 24-hr re-entry interval.
		Grapple$_2$				
		Admire 240 F	Transplant water: 25 mL per 1,000 plants		21	**Cucumber Beetle.** One application/yr applied in-furrow at planting or banded soon after planting. Use 150 mL of water per plant. 24-hr re-entry interval.
		Grapple$_2$				
Foliar Treatment						
cyclodiene organochlorines (group 2A)	endosulfan	Thionex 50 WP[3]	1.1 kg	0.44 kg	13	4-day re-entry interval (cucumbers and melon). 12-day re-entry interval (pumpkins and squash).
		Thiodan 4EC[2]	1.5 L	0.6 L	9	
Not Classified	kaolin clay	Surround WP	12.5–25 kg in 500 L water	5–10 kg in 45 gal water	0	**Cucumber beetle control only.** Use the high rate for the first application and the low rate for subsequent applications. Surround leaves a white residue on leaves and fruit. Do not apply close to harvest.
organophosphate (group 1B)	malathion	Malathion 25W	4.25 kg	1.7 kg	3	**Cucumbers, squash, pumpkins.**
			4–5.5 kg	1.6–2.2 kg	3	**Melons.**
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	1	**Aphids only.** Most effective on young stages of pest development. Slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	48–65 g	0	Use high rate on high populations or dense foliage. 12-hr re-entry interval.
TWO-SPOTTED SPIDER MITE						
tetronic and tetramic acid derivatives (group 23)	spiromesifen	Oberon	500–600 mL	202–243 mL	7	Apply before mite populations begin to build. Slow activity; control may not be apparent for 2–3 weeks. Maximum 3 applications/yr. 12-hr re-entry interval.
CUTWORMS						
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	Apply to small plants when no rain is in the forecast in next 24 hr. 12-hr re-entry interval.
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.48–0.97 L	60	**Cucumbers only.** Apply at 2–5-leaf stage. 24-hr re-entry interval.
		Nufos 4E				
		Pyrinex 480 EC				
carbamate (group 1A)	carbaryl	Sevin XLR	2.5 L	1 L	5	**Climbing cutworms only.** Do not apply during bloom.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.

EGGPLANT

Seed treatments and transplant disease and insect control products registered on eggplant are listed in Table 3–38, *Eggplant Seed Treatment and Transplant Production Disease and Insect Control.* Activities of products for eggplant diseases are listed in Table 3–39, *Activity of Fungicides on Eggplant Diseases.* Activities of products for eggplant insects are listed in Table 3–40, *Activity of Insecticides on Eggplant Insects.* Products registered for eggplant diseases and insects are listed in Table 3–41, *Eggplant Disease and Insect Control.*

Table 3–38. Eggplant Seed Treatment and Transplant Production Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate	Notes
Seed and Seedling Disease				
phenylamide (group 4)	metalaxyl-M and S-isomer	Apron XL LS	20–40 mL/ 100 kg of seed	Seed treatment. **Pythium damping-off.** For import use only – not for domestic commercial or on-farm treatment.
phenylpyrrole (group 12)	fludioxonil	Maxim 480FS	5.2–10.4 mL/ 100 kg of seed	Seed treatment. Seed decay, damping-off and seedling blight caused by **Fusarium and Rhizoctonia.** For import use only. For application by commercial seed treaters only.
QoI (group 11)	azoxystrobin	Dynasty 100FS	25–50 mL/ 100 kg of seed	**Damping-off (Rhizoctonia solani).** For import use only. Not for domestic commercial or on-farm seed treatment.
dithiocarbamate (group M3)	thiram	Thiram 75 WP	65–80 g/ 25 kg of seed	Seed treatment. Seed decay, seedling blight, damping-off.
pthalamide (group M4)	captan	Maestro 80DF	1.25 kg/ 1,000 L of water	Soil drench treatment. **Damping-off, fungus root rot.** 48-hr re-entry interval.
		Supra Captan 80 WDG	Apply 50–85 L of solution per 100 m^2.	
Insects				
Not Classified	*Beauveria bassiana*	BotaniGard 22WP	0.25–1.0 kg/ 400 L of water	Whitefly, aphids, thrips. 4-hr re-entry interval. Spray to wet, but avoid runoff.

Table 3–39. Activity of Fungicides on Eggplant Diseases

		Greenhouse (transplants)		Field		
Common Name	Trade Name	Damping-Off (Seedlings)	Root Disease	Anthracnose	Early Blight	Botrytis Grey Mould
captan	Maestro 80DF	✔				
	Supra Captan 80 WDG	✔				
pyraclostrobin	Cabrio EG			✔	✔	
boscalid	Lance WDG/ Cantus WDG				✔	✔
difenoconazole	Inspire			✔	✔	
Bacillus subtilis	Serenade ASO				+	+
copper sulfate	Copper 53W				✔	

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

Table 3–40. Activity of Insecticides on Eggplant Insects

Common Name	Trade Name	Greenhouse (Transplant)	Field						
		Whitefly, Aphids, Thrips	Aphids	Colorado Potato Beetle	Cutworms (Early-Season)	Mites	Tarnished Plant Bug	Stink Bug	Flea Beetle
Beauveria bassiana	BotaniGard 22WP	✔							
chlorantraniliprole	Coragen			✔	✔				
imidacloprid	Admire 240 F			✔					
	Alias 240 SC			✔					
	Grapple$_2$			✔					
endosulfan	Thiodan 50 WP		✔	✔					✔
	Thionex 50 WP		✔	✔					✔
spinosad	Entrust 80 W			✔					
	Success 480 SC			✔					
spirotetramat	Movento 240 SC		✔						
thiamethoxam	Actara 25WG		✔						
flonicamid	Beleaf 50SG		✔						
malathion	Malathion 25W		✔						
carbaryl	Sevin XLR			(✔)			(✔)	✔	✔
dimethoate	Cygon 480						✔		
	Lagon 480						✔		
spiromesifen	Oberon Flowable					✔			

✔ = control

(✔) = registered but not considered effective or resistance is documented

blank cell = not registered for control of this pest

Table 3–41. Eggplant Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ANTHRACNOSE AND ALTERNARIA (EARLY BLIGHT)						
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	0	Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	175–315 g	71–127 g	0	**Alternaria.** Also controls botrytis grey mould at 420 g/ha rate. Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	292–512 mL	118–207 mL	0	**Anthracnose and alternaria.** Use high rate for anthracnose control. Apply no more than 2 sequential applications. 12-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	8–15 kg	3.2–6.1 kg	0	**Alternaria only. Suppression only.** Also suppresses grey mould. Make first application when conditions are conducive to disease development. Repeat at 5–7-day intervals.
CUTWORMS						
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	**Black cutworm.** Apply to small plants, when no rain is forecast in next 24 hr. 12-hr re-entry interval.
COLORADO POTATO BEETLE						
Transplant Treatment						
neonicotinoid (group 4A)	imidacloprid	Admire 240 F Alias 240 SC Grapple$_2$	7–10 mL/ 100 m of row	2–3 mL/ 100 ft of row	70	Apply in-furrow at transplanting. Consult the label for application details. Do not apply a foliar neonicotinoid in the same season as a soil application. 24-hr re-entry interval.
Foliar Treatments						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
neonicotinoid (group 4A)	imidacloprid	Admire 240 F Alias 240 SC Grapple$_2$	200 mL	81 mL	7	Do not apply a foliar neonicotinoid in the same season as a soil application. Alternate applications with other insecticide groups. 24-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	1.5–2.75 L	0.6–1.1 L	27	4-day re-entry interval.
		Thionex 50 WP[3]	1.1–2.25 kg	0.45–0.9 kg	27	9-day re-entry interval.
spinosyn (group 5)	spinosad	Entrust 80 W	50 g	20 g	1	Use only on small larvae and low infestations. Maintain a spray water pH of 6 or greater.
		Success 480 SC	83 mL	34 mL	1	

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.

Table 3-41. Eggplant Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
FLEA BEETLES AND APHIDS						
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	1	**Aphids only.** Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with an adjuvant. See label for details. 12-hr re-entry interval.
neonicotinoid (group 4A)	thiamethoxam	Actara 25 WG	105 g	43 g	1	**Aphids only.** Do not apply a foliar neonicotinoid in the same season as a soil application. Alternate applications with other insecticide groups. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	0	**Aphids only.** 12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	1.5–2.75 L	0.6–1.1 L	27	4-day re-entry interval.
		Thionex 50 WP[3]	1.1–2.25 kg	0.45–0.9 kg	27	9-day re-entry interval.
organophosphate (group 1B)	malathion	Malathion 25W	2.25–5.5 kg	0.9–2.2 kg	3	**Aphids only.** Control of aphids with malathion has been inconsistent in many areas.
carbamate (group 1A)	carbaryl	Sevin XLR	2.5 L	1 L	2	**Flea beetles only.**
TARNISHED PLANT BUG						
organophosphate (group 1B)	dimethoate	Cygon 480	500–700 mL	202–283 mL	7	
		Lagon 480				
MITES						
tetronic and tetramic acid derivatives (group 23)	spiromesifen	Oberon Flowable	500–600 mL	202–243 mL	7	Apply before mite populations begin to build up. Control may not be apparent for 2–3 weeks, especially under cool temperatures. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.

GARLIC

Activities of products for garlic diseases are listed in Table 3–42, *Activity of Fungicides on Garlic Diseases.* Activities of products for garlic insects are listed in Table 3–43, *Activity of Insecticides on Garlic Insects.* Products registered for garlic diseases and insects are listed in Table 3–44, *Garlic Disease and Insect Control.*

Table 3-42. Activity of Fungicides on Garlic Diseases

Common Name	Trade Name	Penicillium (Green Mould)	Botrytis	Downy Mildew	Purple Blotch	Allium White Rot
iprodione	Rovral	✔				
boscalid/ pyraclostrobin	Pristine WG		✔	+	✔	
pyraclostrobin	Cabrio EG			✔	✔	
mandipropamid	Revus			✔		
difenoconazole	Inspire				✔	
pyrimethanil	Scala SC		✔		✔	
Bacillus subtilis	Serenade Max		+	+		
dicloran	Botran 75W					✔
diallyl disulfide	DADS					+

✔ = control
+ = suppression
blank cell = not registered for control of this pest

Table 3–43. Activity of Insecticides on Garlic Insects

Common Name	Trade Name	Leek Moth	Aphids	Thrips	Onion Maggot	Cutworms
lambda-cyhalothrin	Matador 120EC	✔		✔		
	Silencer 120 EC			✔		
malathion	Malathion 85E		✔	✔		
chlorpyrifos	Lorsban 4E				✔	✔
	Pyrinex 480 EC				✔	✔
	Nufos 4E				✔	✔

✔ = control
blank cell = not registered for control of this pest

Table 3-44. Garlic Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
PENICILLIUM OR GREEN MOULD DISEASE						
dicarboximide (group 2)	iprodione	Rovral		4 g/L of water		Dip cloves into the Rovral suspension for 30 minutes immediately before planting. 12-hr re-entry interval.
BOTRYTIS, DOWNY MILDEW, PURPLE BLOTCH						
SDHI/QoI (group 7/11)	boscalid/ pyraclostrobin	Pristine WG	1–1.3 kg	0.4–0.5 kg	7	Use high rate for suppression of downy mildew. Do not make sequential applications. 3-day re-entry interval for thinning.
QoI (group 11)	pyraclostrobin	Cabrio EG	0.56–0.84 kg	0.23–0.34 kg	7	**Downy mildew and purple blotch.** 12-hr re-entry interval. 3-day re-entry interval for hand-thinning activities.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	162–243 mL	7	**Downy mildew.** Use of a non-ionic surfactant (0.25% v/v) or mineral oil (1% v/v) is recommended. 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	364–512 mL	147–207 mL	7	**Purple blotch.** Apply no more than 2 sequential applications. Maximum 2.04 L/ha per year. 12-hr re-entry interval.
anilino-pyrimidines (group 9)	pyrimethanil	Scala SC	2 L	0.8 L	7	**Purple blotch and botrytis.** Begin applications prior to onset of disease (humid weather, rain, heavy dews). Apply on a 7–14-day interval. 12-hr re-entry interval. 24-hr re-entry interval for hand thinning.
microbial (group 44)	*Bacillus subtilis*	Serenade Max	3–4.5 kg	1.2–1.8 kg	0	**Botrytis. Suppression only.** Begin applications at the first sign of disease or when conditions favour disease development.
			3–6 kg	1.2–2.4 kg	0	**Downy mildew. Suppression only.** Begin applications at the first sign of disease or when conditions favour disease development.
ALLIUM WHITE ROT						
aromatic hydrocarbons (group 14)	dicloran	Botran 75W	6 kg	2.4 kg		Apply 1–2 weeks prior to planting and work into top 4 cm of soil. 12-hr re-entry interval.
Not Classified	diallyl disulfide	DADS	10 L	4 L		**Suppression only.** Soil-injected into seed-bed–ready fields at least 6 months before planting alliums. Seal soil immediately after application with mechanical packer. Use minimum of 500 L of water/ha.
LEEK MOTH, THRIPS, APHIDS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	188 mL in 500 L water	76 mL in 45 gal water	14	**Leek moth and thrips only.** 24-hr re-entry interval.
		Silencer 120 EC				**Thrips only.** 24-hr re-entry interval.
organophosphate (group 1B)	malathion	Malathion 85E	535–1,345 mL	216–544 mL	3	**Thrips and aphids.**
ONION MAGGOT						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	3.5 L in 1,000 L of water	1.4 L in 90 gal of water	50	Apply as a drench over the row on newly emerged plants (in the spring). 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				

[1] PHI = Pre-Harvest Interval (days).

HERBS

Seed treatments registered on herbs are listed in Table 3–45, *Herb Seed Treatments*. Products registered for herb diseases and insects are listed in Table 3–46, *Herb Insect and Disease Control*. There are limited options for chemical pest control in herb crops. Note that not all culinary herbs commonly grown in Ontario are included in the Herb and Spice Group for the purpose of pest control product registration. For pest control products for parsley and chervil, see *Lettuce, Endive & Parsley*, opposite page. For pest control on chives, see *Onions, Leeks & Shallots*, on page 73.

Table 3–45. Herb Seed Treatments

Trade Name	Active ingredients	Rate	Pests Controlled	Notes
Maxim 480FS	fludioxonil	5.2–10.4 mL/ 100 kg seed	Seed decay, damping-off and seedling blights	**For use by commercial seed treaters only.** Crop group registration.

Table 3–46. Herb Insect and Disease Control

Group	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
GREENHOUSE TRANSPLANT DISEASE CONTROL (OREGANO, BASIL, PARSLEY, THYME, DILL)						
microbial (group 44)	*Gliocladium catenulatum*	Prestop	100 g/20 L water (0.5% solution) treats 10 m^2			Growing media or drench application at planting or later, as needed. Suppression of damping-off caused by *Pythium* spp. and *Rhizoctonia solani* when applied at planting and pythium crown and root rot with repeat applications. Suppression of *Fusarium oxysporum* root and stem wilt of basil only. **Greenhouse use only.**
APHIDS, WHITEFLIES, SPIDER MITES						
soap/ pyrethroid	potassium salts of fatty acids/pyrethrins	Safer's Trounce	5 L	2 L	1	Apply in 100 L of water. Repeat as required, according to application intervals specified on label. Crop group registration.
soap	potassium salts of fatty acids	Opal Insecticidal Soap	8 L in 400 L of water		0	Apply dilute solution at a rate of 700–1,900 L/ha. Repeat at 1–2-week intervals to a maximum of 3 consecutive applications. Additional applications may be made if previous experience has shown this will not cause phytotoxicity. Crop group registration.
CABBAGE LOOPER						
biological (group 11)	*Bacillus thuringiensis*	Dipel 2X DF	275–550 g	110–220 g	0	Apply to control small larvae. Maximum 5 applications/yr. Crop group registration.
		Bioprotec CAF	1.4–2.8 L	0.56–1.1 L	0	Crop group registration.

[1] PHI = Pre-Harvest Interval (days).

LETTUCE, ENDIVE & PARSLEY

Seed treatments registered on lettuce are listed in Table 3–47, *Lettuce Seed Treatments*. Activities of products for lettuce, endive and parsley diseases are listed in Table 3–48, *Activity of Fungicides on Lettuce, Endive and Parsley Diseases*. Products registered for lettuce, endive and parsley diseases are listed in Table 3–49, *Lettuce, Endive and Parsley Disease Control*.

Activities of products for lettuce, endive and parsley insects are listed in Table 3–50, *Activity of Insecticides on Lettuce, Endive and Parsley Insects*. Products registered for lettuce, endive and parsley insects are listed in Table 3–51, *Lettuce, Endive and Parsley Aphid, Cutworm and Tarnished Plant Bug Control*, and Table 3–52, *Lettuce, Endive and Parsley Insect Control*.

Table 3–47. Lettuce Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Ridomil Gold 1G	metalaxyl-M	25 kg/treated ha (10 kg/treated acre)	damping-off (*Pythium*)	**Head lettuce.** Apply with seed in-furrow. Use 115 g/100 m of row. Do not use on transplants.
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	
Thiram 75 WP	thiram	90 g/ 25 kg of seed	seed decay, seedling blight, damping-off	Seed box treatment.
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg of seed	damping-off (*Rhizoctonia solani*)	**For import use only.** Not for domestic commercial or on-farm treatment.

Table 3–48. Activity of Fungicides on Lettuce, Endive and Parsley Diseases

Common Name	Trade Name	Botrytis Grey Mould	Downy Mildew	Lettuce Drop	Powdery Mildew
ferbam	Ferbam 76 WDG	✔			
iprodione	Rovral	✔			
boscalid	Lance WDG/ Cantus WDG	✔		+	
Trichoderma harzianum	Rootshield HC	+			
Bacillus subtilis	Serenade ASO	+	+	+	+
	Serenade Max	+	+	+	+
metalaxyl-M/ mancozeb	Ridomil Gold MZ 68WG		✔		
fosetyl-al	Aliette WDG		✔		
mandipropamid	Revus		✔		
fluopicolide + fosetyl-al	Presidio + Aliette WDG		✔		
dicloran	Botran 75W			✔	
Coniothyrium minitans	Contans WG			+	
quinoxyfen	Quintec				✔

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

Table 3-49. Lettuce, Endive and Parsley Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
BOTRYTIS GREY MOULD						
Greenhouse-Grown Seedlings						
dithiocarbamate (group M3)	ferbam	Ferbam 76 WDG	2 kg/ 1,000 L water			**Lettuce only.** Spray seedlings before transplant.
Field Application						
dicarboximide (group 2)	iprodione	Rovral	1.5 kg	0.6 kg	4	**Lettuce only.** Start after thinning, apply at 7-day intervals. 12-hr re-entry interval.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	285 g	115 g	14	**Lettuce only.** 12-hr re-entry interval.
microbial (group 44)	*Trichoderma harzianum*	Rootshield HC	10 g/1 L water		0	**Lettuce only. Suppression only.** Use quantity of spray solution to cover foliage. See label for details.
	Bacillus subtilis	Serenade ASO	4–12 L	1.6–4.8 L	0	
DOWNY MILDEW						
phenylamides/ dithiocarbamate (group 4/M3)	metalaxyl-M/ mancozeb	Ridomil Gold MZ 68WG	2.5 kg	1 kg	14	**Head lettuce only.** 24-hr re-entry interval.
phosphonate (group 33)	fosetyl-al	Aliette WDG	2.8 kg	1.1 kg	7	**Lettuce only.** 12-hr re-entry interval.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	162–243 mL	1	**Lettuce only.** The use of a non-ionic adjuvant (0.25% v/v) is recommended. 12-hr re-entry interval.
benzamides + phosphonate (group 43+33)	fluopicolide + fosetyl-al	Presidio + Aliette WDG	220–292 mL + 2.8 kg	89–118 mL + 1.1 kg	7	**Lettuce only.** Do not make sequential applications. See product label for rotational restrictions. 12-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade Max	3–6 kg	1.2–2.4 kg	0	**Lettuce only. Suppression only.** Begin applications at the first sign of disease or when conditions favour disease development. Also registered for powdery mildew.
LETTUCE DROP (SCLEROTINIA WHITE MOULD)						
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	385 g	156 g	14	**Lettuce only. Suppression only.** 12-hr re-entry interval.
aromatic hydrocarbons (group 14)	dicloran	Botran 75W	2.3–3.75 kg	0.9–1.5 kg	14	**Lettuce only.** 12-hr re-entry interval.
microbial (group 44)	*Coniothyrium minitans*	Contans WG	2–4 kg	0.8–1.6 kg		**Lettuce only. Suppression only.** Broadcast application, lightly incorporated. Apply to soil prior to or at planting or at time of transplant at least 3 months prior to typical onset of disease. Regular use of Contans WG in successive years within a long-term management strategy will improve disease control. If incorporation will displace soil greater than 5 cm, increase application rate to 3–6 kg/ha (1.2–2.4 kg/ha).
	Bacillus subtilis	Serenade Max	1–3 kg	0.4–1.2 kg	0	**Suppression only.** Begin applications at the first sign of disease or when conditions favour disease development.

[1] PHI = Pre-Harvest Interval (days).

Table 3-50. Activity of Insecticides on Lettuce, Endive and Parsley Insects

Common Name	Trade Name	Aphids	Cutworms	Tarnished Plant Bug	Aster Leafhopper	Cabbage Looper	Pea Leafminer
imidacloprid	Admire 240 F	✔					
	Alias 240 EC	✔					
	Grapple$_2$	✔					
acetamiprid	Assail 70 WP	✔					–
thiamethoxam	Actara 25WG	✔		–			
spirotetramat	Movento 240 SC	✔					
flonicamid	Beleaf 50SG	✔					
endosulfan	Thionex 50 WP	✔				✔	
	Thiodan 4EC	✔		✔		✔	
acephate	Orthene 75 SP	✔				✔	
diazinon	Diazinon 500 E	(✔)					
dimethoate	Cygon 480	✔			✔		
	Lagon 480	✔			✔		
methamidophos	Monitor 480	✔				✔	
naled	Dibrom	(✔)				✔	
lambda-cyhalothrin	Matador 120EC		✔	✔		✔	
	Silencer 120 EC		✔	✔		✔	
cypermethrin	Ripcord 400 EC		✔		✔		
	UP-Cyde 2.5 EC				✔		
permethrin	Pounce 384EC		✔				
	Perm-UP		✔				
	Ambush 500EC		✔				
carbaryl	Sevin XLR			✔	✔		
malathion	Malathion 85E	✔			✔	✔	
kaolin clay	Surround WP				–		
cyromazine	Citation 75WP						✔
Bacillus thuringiensis	Dipel 2X DF					✔	
	Thuricide-HPC					✔	
	Bioprotec CAF					✔	
spinosad	Success 480 SC					✔	
	Entrust 80 W					✔	
spinetoram	Delegate WG					✔	
chlorantraniliprole	Coragen		✔			✔	
methomyl	Lannate TNG					✔	

✔ = control
– = reduction in damage
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

Table 3-51. Lettuce, Endive and Parsley Aphid, Cutworm and Tarnished Plant Bug Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS — AT-PLANTING TREATMENTS						
neonicotinoid (group 4A)	*imidacloprid*	Admire 240 F Alias 240 SC Grapple$_2$		10.2 mL/ 1,000 plants	21	**Transplant tray plug drench. Lettuce only.** Do not follow transplant drench with soil or foliar treatments. 24-hr re-entry interval.
		Admire 240 F Alias 240 SC Grapple$_2$	650 mL	263 mL	21	**Soil application (field drench). Lettuce only.** Apply in 2,000 L water/ha (180 gal/acre) directly over the row. Do not follow soil drench application with foliar treatments. 24-hr re-entry interval.
APHIDS — FOLIAR TREATMENTS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	Also helps control pea leafminer. Alternate applications with other insecticide families. 12-hr re-entry interval.
	imidacloprid	Admire 240 F Alias 240 SC Grapple$_2$	200 mL	81 mL	7	**Lettuce only.** Do not make a foliar imidacloprid application following a plug treatment or soil drench application. 24-hr re-entry interval.
	thiamethoxam	Actara 25WG	105 g	42 g	7	Apply in sufficient water volume to ensure adequate coverage. Use at least 100 L of water/ha. 12-hr re-entry interval.
tetronic and tetramic acid derivative (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	3	Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	48–65 g	0	Use higher rates for high pest populations or dense foliage. 12-hr re-entry interval.
cyclodiene organochlorines (group 2 A)	endosulfan	Thiodan 4EC[2]	2 L	0.8 L	14	**Head lettuce only.** 4-day re-entry interval.
		Thionex 50 WP[3]	1.75 kg	0.7 kg	17	**Head lettuce only.** 4-day re-entry interval.
organophosphate (group 1B)	acephate	Orthene 75 SP	563–825 g	228–334 g	7	**Head lettuce only.** 24-hr re-entry interval. Workers must wear gloves in the field for 2 weeks following application.
	diazinon[4]	Diazinon 500 E	1.1 L	0.4 L	10	**Lettuce only.**
	dimethoate	Cygon 480 Lagon 480	0.7 L	0.3 L	7	**Leaf lettuce only.** Do not use on head lettuce.
	methamidophos	Monitor 480[5]	1.1–2.25 L	0.4–0.9 L	14	**Head lettuce only.**
	naled[4]	Dibrom	1.1–1.65 L	0.4–0.66 L	4	**Lettuce only.** 48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.
[4] Control of aphids with naled and diazinon has been inconsistent in many areas.
[5] Registration expires on December 31, 2012.

Table 3-51. Lettuce, Endive and Parsley Aphid, Cutworm and Tarnished Plant Bug Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	3	**Head lettuce only.** 24-hr re-entry interval. Dark-sided and white cutworms only.
		Silencer 120 EC				
	cypermethrin	Ripcord 400 EC	175 mL	71 mL	21	Do not disturb soil for 5 days after treating.
	permethrin	Pounce 384EC	180–390 mL	73–158 mL		Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. Use high rate on large larvae, dry soils or muck soils. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL		
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	**Black cutworms.** Apply to small plants, when no rain is forecast in next 24 hr. 12-hr re-entry interval.
TARNISHED PLANT BUG						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	3	**Head and leaf lettuce.** 24-hr re-entry interval.
		Silencer 120 EC				**Head lettuce only.** 24-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	2 L	0.8 L	14	**Head lettuce only.** 4-day re-entry interval.
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–5.25 L	1–2.1 L	5	**Head lettuce only.**
neonicotinoid (group 4A)	thiamethoxam	Actara 25WG	210 g	85 g	7	**Reduction in damage.** Apply in sufficient water volume to ensure adequate coverage. Use at least 100 L of water/ha. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.
[4] Control of aphids with naled and diazinon has been inconsistent in many areas.
[5] Registration expires on December 31, 2012.

Table 3-52. Lettuce, Endive and Parsley Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ASTER LEAFHOPPER						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	125 mL	51 mL	14	**Lettuce only.** 12-hr re-entry interval.
		UP-Cyde 2.5 EC	200 mL	81 mL	14	
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1 L	5	**Head lettuce.**
					21	**Leaf lettuce, endive, parsley.**
organophosphate (group 1B)	malathion	Malathion 85E	735–1,345 mL	297–544 mL	14	**Leaf lettuce.**
					3	**Head lettuce.**
Not Classified	kaolin clay	Surround WP	12.5–25 kg in 500 L water	5–10 kg in 45 gal water	0	**Lettuce and parsley.** For early applications, use the higher rate per 500 L water. Surround WP forms a barrier film, which acts as a broad spectrum protectant that may decrease damage from aster leafhoppers.
PEA LEAFMINER						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	86 g	35 g	7	Do not apply more than once every 7 days. 12-hr re-entry interval.
cyromazine (group 17)	cyromazine	Citation 75WP	188 g in 200 L water	76 g in 18 gal water	7	See the label for a full list of leafy greens this product is registered for use on. 12-hr re-entry interval.
CABBAGE LOOPER						
biological (group 11)	*Bacillus thuringiensis*	Dipel 2X DF	275–550 g	111–222 g	0	**Lettuce and parsley.** 275 g/ha rate maximum for parsley.
		Thuricide-HPC	2–4.25 L	0.8–1.7 L	0	**Lettuce only.**
		Bioprotec CAF	1.4–2.8 L	0.6–1.1 L	0	**Lettuce and parsley.**
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	74 mL	1	Maintain a spray pH of 6 or greater. See the label for a full list of leafy greens this product is registered for use on.
		Entrust 80 W	109 g	44 g	1	
	spinetoram	Delegate WG	140–200 g	57–80 g	1	Use high rate for heavy infestations or large larvae. 12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	12-hr re-entry interval.
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	3	**Head lettuce only.** 24-hr re-entry interval.
		Silencer 120 EC				
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	2 L	0.8 L	14	**Head lettuce only.** 4-day re-entry interval.
		Thionex 50 WP[3]	1.75 kg	0.7 kg	17	**Head lettuce only.** 4-day re-entry interval.
carbamate (group 1A)	methomyl	Lannate TNG	0.51–1.0 kg	0.2–0.4 kg	7	**Lettuce only.** 12-hr re-entry interval. 24-hr re-entry interval for hand harvest, pruning and thinning.
organophosphate (group 1B)	acephate	Orthene 75 SP	563–825 g	228–334 g	7	**Head lettuce only.** 24-hr re-entry interval. Workers must wear gloves in the field for 2 weeks following application.
	methamidophos	Monitor 480[4]	1.1–2.25 L	0.4–0.9 L	14	**Head lettuce only.**
	naled	Dibrom	1.1–1.65 L	0.4–0.7 L	4	**Lettuce only.** 48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2013.
[3] Registration expires on July 1, 2013.
[4] Registration expires on December 31, 2012.

ONIONS, LEEKS & SHALLOTS

Seed treatments registered on onions are listed in Table 3–53, *Onion Seed Treatments*. Activities of products for onion, leek and shallot diseases are listed in Table 3–54, *Activity of Fungicides on Allium Diseases*. Products registered for onion, leek and shallot diseases are listed in Table 3–55, *Allium Disease Control*.

Activities of products for onion, leek and shallot insects are listed in Table 3–56, *Activity of Insecticides on Allium Insects*. Products registered for onion, leek and shallot insects are listed in Table 3–57, *Allium Insect Control*.

Table 3–53. Onion Seed Treatments

Active Ingredient(s)	Trade Name	Rate	Insects and Diseases			Notes
			Onion Maggot	Damping-Off	Onion Smut	
cyromazine	Governor 75WP	66.7 g/ kg of seed	✔			**Imported seed only.** Only on muck soils. Do not plant treated seed in the same field in consecutive years. Pre-harvest interval for green onions is 60 days; 100 days for dry onions.
metalaxyl-M	Apron XL LS	20 mL/ 100 kg of seed		✔		**For use in commercial seed-treatment plants only.**
thiram	Thiram 75 WP	65–80 g/ 25 kg of seed		✔		Seed box treatment.
carbathiin/ thiram	Pro-Gro	25 g/ kg seed			✔	Pro-Gro treated seed may be stored for up to 4 months.
azoxystrobin	Dynasty 100FS	25–50 mL/ 100 kg of seed		✔		**For import use only.** Not for domestic commercial or on-farm seed treatment. See label for complete list of registered crops.

Table 3–54. Activity of Fungicides on Allium Diseases

Active Ingredient	Trade Name	Botrytis Leaf Blight	Downy Mildew	Onion Smut	Purple Blotch	Allium White Rot
chlorothalonil	Bravo 500	✔				
	Echo 720	✔				
mancozeb	Dithane DG Rainshield	✔		✔		
	Penncozeb 80WP	✔				
	Manzate Pro-Stick	✔	✔		✔	
metalaxyl-M/ mancozeb	Ridomil Gold MZ 68WG		✔			
pyraclostrobin/ boscalid	Pristine WG	✔	+		✔	
boscalid	Lance WDG/ Cantus WDG	✔			✔	
pyraclostrobin	Cabrio EG		✔		✔	
difenoconazole	Inspire				✔	
iprodione	Rovral	✔	✔[1]			
fosetyl-al	Aliette WDG		✔		✔	
cyprodinil/ fludioxonil	Switch 62.5 WG	✔			+	
pyrimethanil	Scala SC	✔			✔	
mandipropamid	Revus		✔			
Bacillus subtilis	Serenade Max	+	+			
diallyl disulfide	DADS					+
fenamidone	Reason 500SC		+			

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

[1] When tank-mixed with label rates of mancozeb.

Table 3–55. Allium Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
SMUT						
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	4.4–8.8 kg	1.8–3.5 kg	100	Apply in-furrow at seeding time. Use high rate only where smut pressure is high.
DOWNY MILDEW, BOTRYTIS LEAF BLIGHT, PURPLE BLOTCH						
chloronitrile (group M5)	chlorothalonil	Bravo 500	2.4–4.8 L	1–1.9 L	7	**Dry bulb onions only. Botrytis leaf blight.** 48-hr re-entry interval.
					14	**Green bunching only. Botrytis leaf blight.** 48-hr re-entry interval.
		Echo 720	1.7–3.3 L	0.7–1.3 g	7	**Dry bulb onions only. Botrytis leaf blight.** 48-hr re-entry interval.
					14	**Green bunching only. Botrytis leaf blight.** 48-hr re-entry interval.
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	2.25–3.25 kg	0.9–1.3 kg	10	**Dry onions only. Botrytis leaf blight.** 24-hr re-entry interval.
		Penncozeb 80WP				
		Manzate Pro-Stick	2.25–3.25 kg	0.9–1.3 kg	10	**Dry bulb onions only.** 24-hr re-entry interval.
phenylamide/ dithiocarbamate (group 4/M3)	metalaxyl-M/ mancozeb	Ridomil Gold MZ 68WG	2.5 kg	1 kg	7	**Onions only. Downy mildew.** Apply before first outbreak of disease. 24-hr re-entry interval.
QoI/ SDHI (group 11/7)	pyraclostrobin/ boscalid	Pristine WG	1–1.3 kg	0.4–0.5 kg	7	Use high rate for suppression of downy mildew. Do not make sequential applications. 72-hr re-entry interval for thinning.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	475 g	192 g	7	**Purple blotch and botrytis leaf blight.** Apply before disease develops. Do not apply more than 2 sprays before rotating to a different fungicide family. 12-hr re-entry interval.
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	226–340 g	7	**Purple blotch and downy mildew.** Do not apply more than 2 sprays before rotating to a different fungicide family. 12-hr re-entry interval. 72-hr re-entry for hand-thinning activities.
DMI (group 3)	difenoconazole	Inspire	364–512 mL	147–207 mL	7	**Purple blotch.** Apply no more than 2 sequential applications. For green onions, apply no more than 1.53 L/ha per year. For dry bulb onions, apply no more than 2.04 L/ha per year. 12-hr re-entry interval.
dicarboximide (group 2)	iprodione	Rovral[2]	0.75–1.5 kg in 300–500 L water	303–607 g in 30–50 gal water	15	**Onions and leeks only.** 12-hr re-entry interval.
phosphonate (group 33)	fosetyl-al	Aliette WDG	2.8 kg	1.1 kg	7	**Onions only. Downy mildew and purple blotch.** 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

[2] Rovral when tank-mixed with label rates of mancozeb will control botrytis leaf blight and downy mildew. Apply on a preventative basis. This tank-mix combination will help reduce the chance of resistance to Rovral.

Table 3-55. Allium Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
phenylpyrroles/ anilino-pyramidines (group 12/9)	cyprodinil/ fludioxonil	Switch 62.5 WG	775–975 g	313–394 g	7	**Dry bulb and green onions only. Botrytis leaf blight and suppression of purple blotch.** Do not make more than 2 sequential applications. 12-hr re-entry interval.
anilino-pyrimidines (group 9)	pyrimethanil	Scala SC	2 L	0.8 L	7	**Botrytis leaf blight and purple blotch.** Begin applications prior to onset of disease (humid weather, rain or heavy dews). Apply on 7–14-day spray interval. 12-hr re-entry interval. 24-hr re-entry interval for thinning.
anilino-pyrimidines + chloronitrile (group 9+M5)	pyrimethanil + chlorothalonil	Scala SC + Bravo 500	1 L + 2.4–4.8 L	0.8 L + 1–1.9 L	7	**Onions only. Botrytis leaf blight.** Begin applications prior to onset of disease (humid weather, rain or heavy dews). Apply on 7–14-day spray interval. 48-hr re-entry interval.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	161–243 mL	7	**Downy mildew only.** The use of a non-ionic adjuvant (0.25% v/v) is recommended. 12-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade Max	3–4.5 kg	1.2–1.8 kg	0	**Botrytis suppression.** Begin applications at the first sign of disease or when conditions favour disease development.
			3–6 kg	1.2–2.4 kg	0	**Downy mildew suppression.** Begin applications at the first sign of disease or when conditions favour disease development.
ALLIUM WHITE ROT						
Not Classified	diallyl disulfide	DADS	10 L	4 L		**Suppression only.** Soil-injected into seed-bed–ready fields at least 6 months before planting alliums. Seal soil immediately after application with mechanical packer. Use minimum of 500 L of water/ha.

[1] PHI = Pre-Harvest Interval (days).

[2] Rovral when tank-mixed with label rates of mancozeb will control botrytis leaf blight and downy mildew. Apply on a preventative basis. This tank-mix combination will help reduce the chance of resistance to Rovral.

Table 3-56. Activity of Insecticides on Allium Insects

Common Name	Trade Name	Cutworms	Leek Moth	Onion Maggot Larvae	Onion Maggot Flies	Onion Thrips[1]
chlorpyrifos	Lorsban 15G			✔		
	Pyrifos 15G			✔		
	Lorsban 4E	✔				
	Pyrinex 480 EC	✔				
	Nufos 4E	✔				
cypermethrin	Ripcord 400 EC	✔			✔	(✔)
	UP-Cyde 2.5 EC				✔	(✔)
diazinon	Diazinon 50 W				✔	✔
	Diazinon 500 E				✔	✔
naled	Dibrom				✔	✔
lambda-cyhalothrin	Matador 120EC		✔			(✔)
	Silencer 120 EC					(✔)
deltamethrin	Decis 5 EC					(✔)
spinosad	Success 480 SC		+			
	Entrust 80 W		+			
permethrin	Pounce 384EC	✔				
	Perm-UP	✔				
	Ambush 500EC	✔				

✔ = control
\+ = suppression
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

[1] Resistance to these insecticides (✔) has been observed in Ontario muck soils.

Table 3–57. Allium Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ONION MAGGOT						
Soil Treatment (In-Furrow Granular)						
organophosphate (group 1B)	chlorpyrifos	Lorsban 15G Pyrifos 15G	7.9–15.7 kg	3.2–6.3 kg	109	**Dry onions only.** 24-hr re-entry interval. See the label for spacing and planter specifications.
					97	**Pickling onions only.** 24-hr re-entry interval. See the label for spacing and planter specifications.
Foliar Sprays for Onion Maggot Flies						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	175 mL	71 mL	3	**Onions only.**
		UP-Cyde 2.5 EC	280 mL	113 mL	3	**Onions only.** 12-hr re-entry interval.
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1 kg	0.4 kg	10	**Onions only.**
		Diazinon 500 E	1.1 L	0.4 L	10	**Onions only.** 3-day re-entry interval.
	naled	Dibrom	550 mL	222 mL	4	**Onions only.** 48-hr re-entry interval.
THRIPS						
pyrethroid[2] (group 3A)	lambda-cyhalothrin	Matador 120EC	188 mL in 500 L water	76 mL in 50 gal water	14	24-hr re-entry interval. 10-day re-entry interval for hand harvest and thinning in green onions.
		Silencer 120 EC				
	cypermethrin	Ripcord 400 EC	175 mL	71 mL	3	**Onions only.**
		UP-Cyde 2.5 EC	280 mL	113 mL	3	**Onions only.** Apply at 10-day intervals. 12-hr re-entry interval.
	deltamethrin	Decis 5 EC	200 mL	81 mL	5	**Onions only.** Maximum 1 application/yr.
organophosphate (group 1B)	naled	Dibrom	550 mL	222 mL	4	**Onions only.** 48-hr re-entry interval.
LEEK MOTH						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	188 mL in 500 L water	76 mL in 50 gal water	14	24-hr re-entry interval. 10-day re-entry for hand harvest and thinning of green onions.
spinosyn (group 5)	spinosad	Success 480 SC	218 mL	88 mL	3	Green onions, leeks and chives. **Suppression only.** Apply 1 week after peak pheromone trap capture.
		Entrust 80 W	132 g	53 g		
CUTWORMS						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	175 mL	71 mL	21	**Onions only.** Do not disturb soil for 5 days after treating.
	permethrin	Pounce 384EC	180–390 mL	73–158 mL		**Onions only.** Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. Use high rate on large larvae, dry soils or muck soils. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL		
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	2.4–4.8 L	1–1.9 L	60	**Dry onions (bulb and pickling) only.** Apply between 2–5-leaf stage. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E	2.4–4.8 L	1–1.9 L	60	**Bulb onions only.** Apply between 2–5-leaf stage. 24-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Resistance to these insecticides has been observed in Ontario muck soils.

PARSNIPS

Seed treatments registered on parsnips are listed in Table 3–58, *Parsnip Seed Treatments*. Activities of products for parsnip diseases and insects are listed in Table 3–59, *Activity of Fungicides and Insecticides on Parsnip Diseases and Insects*. Products registered for parsnip diseases and insects are listed in Table 3–60, *Parsnip Disease and Insect Control*.

Table 3–58. Parsnip Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	**For use in commercial seed-treatment plants only.**
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping-off (*Rhizoctonia solani*)	**For import use only.** Not for domestic commercial or on-farm seed treatment.

Table 3–59. Activity of Fungicides and Insecticides on Parsnip Diseases and Insects

Common Name	Trade Name	Damping-Off (*Pythium*)	Damping-Off (*Rhizoctonia*)	Phoma Canker	Botrytis Grey Mould	Carrot Rust Fly Adults	Aphids
metalaxyl-M	Apron XL LS	✔					
azoxystrobin	Dynasty 100FS		✔				
chlorothalonil	Bravo 500			✔			
	Echo 720			✔			
cyprodinil/ fludioxonil	Switch 62.5 WG				✔		
diazinon	Diazinon 500 E					✔	✔
	Diazinon 50 W					✔	✔
flonicamid	Beleaf 50SG						✔

✔ = control
blank cell = not registered for control of this pest

Table 3–60. Parsnip Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
PHOMA CANKER						
chloronitrile (group M5)	chlorothalonil	Bravo 500	2.8 L	1.1 L	7	48-hr re-entry interval.
		Echo 720	1.9 L	0.8 L	7	
CARROT RUST FLY (ADULTS ONLY)						
organophosphate (group 1B)	diazinon	Diazinon 500 E	1.1 L	0.4 L	10	3-day re-entry interval.
		Diazinon 50 W	1.1 kg	0.4 kg	10	
APHIDS						
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	3	Thorough spray coverage is essential for optimum control. Use higher rates for greater pest populations and/or dense foliage. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

PEAS

Seed treatments registered on peas are listed in Table 3–61, *Pea Seed Treatments*. Activities of products for pea diseases and insects are listed in Table 3–62, *Activity of Fungicides and Insecticides on Pea Diseases and Insects*. Products registered for pea diseases are listed in Table 3–63, *Pea Disease Control*. Product registered for pea insects are listed in Table 3–64, *Pea Insect Control*.

Table 3–61. Pea Seed Treatments

		Insects		Diseases				
Active Ingredient(s)	Trade Name	Seedcorn Maggots	Wireworm	Ascochyta[1]	Pythium	Fusarium	Rhizoctonia	Notes
thiamethoxam + metalaxyl-M/ fludioxonil	Cruiser 5 FS + Apron Maxx RFC	✔	✔	✔	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product labels for rates. Use the high rate for wireworm and broad spectrum seedling disease control. High rate also controls early-season soybean aphid.
diazinon/ captan	Agrox B-2	✔			✔	✔	✔	Seed box or slurry treatment. Use 80 g/25 kg of seed. Do not use on seed previously treated with an insecticide. Use within 1 month of treatment.
diazinon/ captan	Agrox CD	✔			✔	✔	✔	Seed box treatment. Use 50 g/25 kg of seed. Use on seed previously treated with captan or thiram. Do not use on seed previously treated with an insecticide.
fludioxonil/ metalaxyl-M	Apron Maxx RFC			✔	✔	✔	✔	**For use in commercial or on-farm seed-treatment equipment only.** Use 100 mL/100 kg of seed.
metalaxyl-M	Apron XL LS				✔			**For use in commercial seed-treatment plants only.** See the product label for rates.
metalaxyl	Allegiance FL				✔			**For use in commercial seed-treatment plants only.** See the product label for rates.
carbathiin/ thiram	Vitaflo			✔	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product label for rates. Do not store treated seed.
thiram	Thiram 75 WP				✔	✔	✔	Seed box treatment. Use 25–30 g per 25 kg of seed.
Trichoderma harzianum	Rootshield HC				+	+	+	Seed box treatment. 60–125 g/50 kg of seed.
thiamethoxam	Cruiser 5 FS	✔	✔					**For use in commercial seed-treatment plants only.** See product label for rates. Request the high rate for wireworm control. High rate also controls early-season soybean aphid.

✔ = registered for control of this pest
\+ = suppression
blank cell = not registered for control of this pest

[1] Seed-borne.

Table 3-62. Activity of Fungicides and Insecticides on Pea Diseases and Insects
For information on seed decay, root rots and seed insects, see Table 3-61, *Pea Seed Treatments*, opposite page.

Common Name	Trade Name	Ascochyta (*Mycosphaerella*) Blight	White Mould (*Sclerotinia*)	Powdery Mildew	Slugs	Aphids	Cutworms	Western Bean Cutworm
pyraclostrobin	Headline EC	✔		*				
boscalid	Lance WDG	✔	✔					
sulfur	Microthiol Disperss			✔				
lambda-cyhalothrin	Matador 120EC					✔	✔	✔
	Silencer 120 EC					✔	✔	✔
dimethoate	Cygon 480					✔		
	Lagon 480					✔		
malathion	Malathion 25W					(✔)		
methomyl	Lannate TNG					✔		
naled	Dibrom					✔		
ferric phosphate	Sluggo Professional				✔			
chlorantraniliprole	Coragen							✔
permethrin	Pounce 384EC						✔	
	Perm-UP						✔	
	Ambush 500EC						✔	

✔ = control
(✔) = registered but not considered effective or resistance is documented
* = some control of this pest may be expected when this product is used to control labelled pests
blank cell = not registered for control of this pest

Table 3-63. Pea Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
MYCOSPHAERELLA AND ASCOCHYTA BLIGHT						
QoI (group 11)	pyraclostrobin	Headline EC	400–600 mL	162–243 mL	7	12-hr re-entry interval.
SDHI (group 7)	boscalid	Lance WDG	420 g	170 g	7	12-hr re-entry interval.
WHITE MOULD (SCLEROTINIA) AND POWDERY MILDEW						
SDHI (group 7)	boscalid	Lance WDG	560–770 g	227–312 g	7	**White mould.** 12-hr re-entry interval.
inrganic (group M2)	sulfur	Microthiol Disperss	1.5 kg	0.6 kg	1	**Powdery mildew.** 24-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

Table 3-64. Pea Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83–233 mL	34–94 mL	14	May also control lygus bugs. Do not feed or graze treated vines. 24-hr re-entry interval.
		Silencer 120 EC				
carbamate (group 1A)	methomyl	Lannate TNG	510 g	206 g	1	12-hr re-entry interval.
organophosphate (group 1B)	dimethoate	Cygon 480	275–425 mL	111–172 mL	3	Do not feed or graze vines within 21 days of last application.
		Lagon 480				
	malathion	Malathion 25W	4.25 kg	1.7 kg	3	
	naled	Dibrom	1.1–2.2 L	0.4–0.9 L	4	**Processing only.** 48-hr re-entry interval.
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10–20 kg	0	Use higher rates on severe infestations.
WESTERN BEAN CUTWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	12-hr re-entry interval.
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83–187 mL	34–76 mL	14	May also control lygus bugs. Do not feed or graze treated vines. 24-hr re-entry interval.
		Silencer 120 EC				
CUTWORMS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	14	Apply in the late evening or at night. Do not feed or graze treated vines. 24-hr re-entry interval.
		Silencer 120 EC				
	permethrin	Pounce 384EC	180–390 mL	73–158 mL		Apply in the late evening or at night. Apply up to 5-leaf stage. Use high rates on dry soils and/or large cutworms. Do not disturb soil for 5 days after treating. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–300 mL	57–121 mL		

[1] PHI = Pre-Harvest Interval (days).

PEPPERS

Seed treatments and transplant disease and insect control products registered on peppers are listed in Table 3–65, *Greenhouse Pepper Transplant Disease and Insect Control.* Activities of products for peppers diseases are listed in Table 3–66, *Activity of Fungicides on Pepper Diseases.* Products registered for pepper diseases are listed in Table 3–67, *Pepper Disease Control.*

Activities of products for pepper insects are listed in Table 3–68, *Activity of Insecticides on Pepper Insects.* Products registered for pepper insects are listed in Table 3–69, *Pepper Insect Control.*

Table 3–65. Greenhouse Pepper Transplant Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	Notes
SEED AND SEEDLING DISEASE					
phenylamide (group 4)	metalaxyl-M	Apron XL LS	20–40 mL/ 100 kg of seed		Seed treatment. **Pythium damping-off.** For import use only – not for domestic commercial or on-farm treatment.
phenylpyrrole (group 12)	fludioxonil	Maxim 480FS	5.2–10.4 mL/ 100 kg of seed		Seed treatment. Seed decay, damping-off and seedling blight caused by *Fusarium* and *Rhizoctonia*. **For import use only. For application by commercial seed treaters only.**
QoI (group 11)	azoxystrobin	Dynasty 100FS	25–50 ml/ 100 kg of seed		Damping-off (*Rhizoctonia solani*). For import use only. Not for domestic commercial or on-farm seed treatment.
dithiocarbamate (group M3)	thiram	Thiram 75 WP	90 g/ 25 kg of seed		Seed treatment. Seed decay, seedling blight, damping-off.
pthalamide (group M4)	captan	Maestro 80DF Supra Captan 80 WDG	1.25 kg/ 1,000 L of water Apply 50–85 L of solution per 100 m^2.		Soil drench treatment. **Damping-off, fungus root rot.** 48-hr re-entry interval.
microbial (group 44)	*Trichoderma harzianum*	RootShield Granules	600–750 g per m^3 of loose planting mix or soil		**Suppression.** Root diseases caused by *Pythium, Rhizoctonia, Fusarium.* 4-hr re-entry interval.
		RootShield HC	55–110 g per m^3 of loose planting mix or soil or planting beds		**Suppression.** Root diseases caused by *Pythium, Rhizoctonia, Fusarium.* Potting mix application or drench. 4-hr re-entry interval.
PHYTOPHTHORA BLIGHT AND POWDERY MILDEW					
carboxylic acid amides (group 40)	mandipropamid	Revus	600 mL	243 mL	**Phytophthora blight suppression only.** Make one application as a drench, immediately before transplanting. 12-hr re-entry interval.
microbial (group 44)	*Streptomyces lydicus*	Actinovate SP	425 g/ 1,100 L of water	172 g/ 445 L of water	**Powdery mildew suppression.** 1-hr re-entry interval. Spray to wet, but avoid runoff.
BACTERIAL DISEASES					
inorganic (group M1)	copper hydroxide	Kocide 2000	3.2 kg	1.3 kg	Apply every 5 days, when warranted, to a maximum of 5 applications over a 4-week period prior to transplanting. Apply in low water volumes. 24-hr re-entry interval.
		Coppercide WP	2.25 kg	0.9 kg	
INSECTS					
biological (group 11)	*Bacillus thuringiensis*	Bioprotec 3P	0.8 kg/ 1,000 L of water		*Duponchelia fovealis.* Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stems is necessary.
Not Classified	*Beauveria bassiana*	BotaniGard 22WP	0.25–1.0 kg/ 400 L of water		Whitefly, aphids, thrips. 4-hr re-entry interval. Spray to wet, but avoid runoff.

Table 3–66. Activity of Fungicides on Pepper Diseases

		Greenhouse (Transplants)					Field					
Common Name	**Trade Name**	**Damping-Off (Seedlings)**	**Root Disease**	**Phytophthora Blight**	**Powdery Mildew**	**Bacterial Spot**	**Anthracnose**	**Bacterial Spot**	**Alternaria (Early Blight)**	**Botrytis Grey Mould**	**Powdery Mildew**	**Phytopthora Blight**
captan	Maestro 80DF	✔										
	Supra Captan 80 WDG	✔										
Trichoderma harzianum	RootShield Granules		✔									
	RootShield HC		✔									
mandipropamid	Revus			+								
Streptomyces lydicus	Actinovate SP				+						+	
copper hydroxide	Kocide 2000					✔		✔				
	Coppercide WP					✔		✔				
	Parasol WG							✔				
Bacillus subtilis	Serenade ASO							+	+	+	+	
pyraclostrobin	Cabrio EG						✔		✔			
boscalid	Lance WDG/ Cantus WDG								✔	✔		
difenoconazole	Inspire						✔		✔			
potassium bicarbonate	MilStop										✔	
fluopicolide	Presidio											✔
copper sulfate	Copper 53W						✔		✔			

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

Table 3-67. Pepper Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
BACTERIAL LEAF SPOT						
inorganic (group M1)	copper hydroxide	Parasol WG	2.25–3.25 kg	0.9–1.3 kg	1	Apply at 7–14-day intervals. 48-hr re-entry interval.
		Kocide 2000	2.52–3.2 kg	1–1.3 kg	1	Apply at 7–10-day intervals. 24-hr re-entry interval.
		Coppercide WP	2.25–3.25 kg	0.9–1.3 kg	1	Apply at 7–14-day intervals.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	4–15 kg	1.6–6.1 kg	0	**Suppression only.** Begin applications soon after transplant. Repeat as necessary on a 7–10-day interval. When conditions are conducive to rapid disease development, use in a rotational program with other bactericides.
FUNGAL DISEASES						
QoI (group 11)	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	0	**Anthracnose and alternaria control.** Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	175–315 g	71–127 g	0	**Botrytis grey mould and alternaria.** Use 420 g/ha (170 g/acre) to control botrytis grey mould. Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	292–512 mL	118–207 mL	0	**Anthracnose and alternaria.** Use high rate for anthracnose control. Apply no more than 2 sequential applications. 12-hr re-entry interval
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	8–15 kg	3.2–6.1 kg	0	**Alternaria, powdery mildew, botrytis grey mould — suppression only.** Make first application when conditions are conducive for disease development. Repeat at 5–7-day intervals.
Not Classified	potassium bicarbonate	MilStop	2.8–5.6 kg	1.1–2.3 kg	0	**Powdery mildew.** Spray at 7-day intervals in 1,000 L/ha (10 gal/acre) of water. Use higher rates for heavier disease pressure. 4-hr re-entry interval.
microbial (group 44)	*Streptomyces lydicus*	Actinovate SP	425 g/ 1,100 L of water	172 g/ 445 L of water	0	**Powdery mildew suppression.** 1-hr re-entry interval. Spray to wet, but avoid runoff.

[1] PHI = Pre-Harvest Interval (days).

Table 3-68. Activity of Insecticides on Pepper Insects

		Greenhouse (Transplant)		Field						
Common Name	**Trade Name**	***Duponchella fovealis***	**Whitefly, Aphids, Thrips**	**European Corn Borer**	**Cutworms (Early-Season)**	**Tarnished Plant Bug**	**Stink Bug**	**Aphids**	**Pepper Maggot**	**Mites**
Bacillus thuringiensis	Bioprotec 3P	✔								
Beauveria bassiana	BotaniGard		✔							
spirotetramat	Movento 240 SC							✔		
thiamethoxam	Actara 25WG							✔		
acetamiprid	Assail 70 WP							✔		
flonicamid	Beleaf 50SG							✔		
dimethoate	Cygon 480							✔	✔	
	Lagon 480							✔	✔	
diazinon	Diazinon 50 W							✔		
acephate	Orthene 75 SP			✔				✔	✔	
malathion	Malathion 25W							✔		
endosulfan	Thiodan 50 WP							✔	✔	
	Thiodan 4EC							✔	✔	
	Thionex 50 WP							✔	✔	
chlorantraniliprole	Coragen			✔	✔					
novaluron	Rimon			✔						
deltamethrin	Decis 5 EC			✔						
permethrin	Pounce 384EC			✔	✔					
	Perm-UP			✔	✔					
	Ambush 500EC			✔	✔					
carbaryl	Sevin XLR			✔		✔	(✔)			
spinosad	Success 480 SC			✔						
	Entrust 80 W			✔						
Bacillus thuringiensis	Bioprotec CAF			✔						
chlorpyrifos	Lorsban 4E				✔					
	Pyrinex 480 EC				✔					
	Nufos 4E				✔					
spiromesifen	Oberon Flowable									✔

✔ = control
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

Table 3-69. Pepper Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS AND PEPPER MAGGOT						
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	1	**Aphids only.** Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with an adjuvant. See label for details. 12-hr re-entry interval.
neonicotinoid (group 4A)	thiamethoxam	Actara 25WG	105 g	43 g	1	**Aphids only.** Alternate applications with other insecticide groups. 12-hr re-entry interval.
	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	**Aphids only.** Alternate applications with other insecticide groups. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	0	**Aphids only.** 12-hr re-entry interval.
organophosphate (group 1B)	dimethoate	Cygon 480	0.7–1.0 L	0.3–0.4 L	7	
		Lagon 480			3	
	diazinon[2]	Diazinon 50 W	0.5–1.0 kg	0.2–0.4 kg	5	**Aphids only.** Less effective below 20°C.
	acephate	Orthene 75 SP	562 g	228 g	7	24-hr re-entry interval.
	malathion	Malathion 25W	2.25–5.5 kg	0.9–2.2 kg	3	**Aphids only.** Control of aphids with malathion has been inconsistent in many areas.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[3]	1.5–2.75 L	0.6–1.1 L	27	4-day re-entry interval.
		Thionex 50 WP[4]	1.1–2.25 kg	0.45–0.9 kg	27	9-day re-entry interval.
EUROPEAN CORN BORER						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
benzoylurea (group 15)	novaluron	Rimon 10 EC	410–820 mL	166–332 mL	1	12-hr re-entry interval.
pyrethroid (group 3A)	deltamethrin	Decis	250–300 mL	101–121 mL	3	
	permethrin	Pounce 384EC	180 mL	73 mL	1	12-hr re-entry interval.
		Perm-UP	180 mL	73 mL		
		Ambush 500EC	140 mL	57 mL		
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–5.25 L	1.0–2.1 L	2	In areas where corn borer has been a problem, spray every 4 days.
organophosphate (group 1B)	acephate	Orthene 75 SP	825 g	334 g	7	24-hr re-entry interval.
spinosyn (group 5)	spinosad	Success 480 SC	83 mL	34 mL	1	Use only on small larvae and low infestations. Maintain a spray water pH of 6 or greater.
		Entrust 80 W	50 g	20 g	1	Time application to target egg hatch or very small larvae. Maintain a spray water pH of 6 or greater.
biological (group 11)	*Bacillius thuringiensis*	Bioprotec CAF	2.8 L	1.1 L	1	Apply to young larvae at first signs of infestation; repeat application 2–4 times as necessary.

[1] PHI = Pre-Harvest Interval (days).
[2] Control of aphids with diazinon has been inconsistent in many areas.
[3] Registration expires on December 31, 2013.
[4] Registration expires on July 1, 2013.

Table 3-69. Pepper Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS						
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	**Black cutworm.** Apply to small plants, when no rain is forecast in next 24 hr. 12-hr re-entry interval.
pyrethroid (group 3A)	permethrin	Perm-UP	180–390 mL	73–158 mL	1	Apply in the late evening or at night. Do not disturb soil for 5 days after treating. Use high rates on dry or muck soils or on large larvae. 12-hr re-entry interval.
		Ambush 500EC	140–300 mL	57–121 mL		
		Pounce 384EC	180–390 mL	73–158 mL		
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.5–1 L	40	24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				
MITES						
tetronic and tetramic acid derivatives (group 23)	spiromesifen	Oberon Flowable	500–600 mL	202–243 mL	7	Apply before mite populations begin to build up. Control may not be apparent for 2–3 weeks, especially under cool temperatures. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Control of aphids with diazinon has been inconsistent in many areas.
[3] Registration expires on December 31, 2013.
[4] Registration expires on July 1, 2013.

POTATOES

Seed treatments registered on potatoes are listed in Table 3–70, *Potato Seed Treatments*. Products registered for potato diseases are listed in Table 3–71, *Potato Pythium Leak, Pink Rot, Rhizoctonia, Silver Scurf and Fusarium Dry Rot Control*, Table 3–72, *Potato — Broad Spectrum Protectant Fungicides*, Table 3–73, *Early Blight and Late Blight Protectant Fungicides* and Table 3–74, *Late Blight Targeted Protectant Fungicides*.

Products registered for potato insects are listed in Table 3–75, *Colorado Potato Beetle Control*, Table 3–76, *Potato Insect Control* and Table 3–77, *Potato Crop Aphid Control*.

Table 3–70. Potato Seed Treatments

Group	Common Name	Trade Name	Rate/ 100 kg seed	Diseases or Insects Controlled
Fungicides				
methyl-benzimadazole carbamates (group 1)	thiophanate-methyl	Senator PSPT	500 g	**Fusarium seed piece decay and seed-borne Verticillium**
dithiocarbamates (group M3)	mancozeb	Tuberseal	500 g	**Fusarium seed piece decay**
		Solan MZ Potato ST Fungicide	500 g	**Fusarium seed piece decay**
phenylpyrroles (group 12)	fludioxonil	Maxim PSP[1]	500 g	**Fusarium dry rot and seed-borne Rhizoctonia**
		Maxim Liquid PSP[1]	5.2 mL	**Fusarium dry rot and seed-borne Rhizoctonia**
phenylpyrroles/ dithiocarbamates (group 12/M3)	fludioxonil/ mancozeb	Maxim MZ PSP[1]	500 g	**Fusarium dry rot and seed-borne Rhizoctonia**
Insecticides				
neonicotinoid[2] (group 4A)	clothianidin	Titan ST	10.4–20.8 mL	**Colorado potato beetle, potato flea beetle, potato leafhopper, aphids.**[2] Maximum 1 application per year. For extended control, use the higher rate.
	imidacloprid	Admire SPT	26–39 mL	**Colorado potato beetle, potato flea beetle, potato leafhopper, aphids.**[2]
		Alias 240 EC		
		Grapple$_2$		
	thiamethoxam	Cruiser Potato Seed Piece	24.4 mL	**Colorado potato beetle, potato leafhoppers, aphids.**[2] Maximum rate cannot exceed 488 mL/ha or 195 mL/acre.
	clothianidin	Titan ST	20.8 mL	**Suppression of wireworms only.** Maximum 1 application/yr. Do not dilute with any more than 6 parts water to 1 part Titan ST insecticide. Plant seed pieces as soon as possible after cutting and treating.
Growth Regulator				
carboxilic acid	giberellic acid	Falgro Tablet	1 tablet in 75 L of water (treats 61,000 kg seed)	For increased tuber set and smaller tuber profile for seed, table and processing potatoes.

[1] Maxim treatments may increase the number of stems, leading to smaller tuber size.

[2] Do not apply a foliar neonicotinoid spray in fields where a neonicotinoid was used either in-furrow or as a seed treatment. See *Caution*, on page 94.

Table 3–71. Potato Pythium Leak, Pink Rot, Rhizoctonia, Silver Scurf and Fusarium Dry Rot Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
In-Furrow						
phenylamide (group 4)	metalaxyl-M	Ridomil Gold 480 SL	4 mL/ 100 m of row	1.2 mL/ 100 ft of row	80	**Pink rot.** Apply directly over the seed pieces in-furrow.
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–2 mL/ 100 ft of row	90	**Rhizoctonia stem canker, stolon canker, black scurf.** Suppression of silver scurf. Apply once at planting in 50–140 L of water/ha (5–14 gal/acre). 30-day plant-back restrictions.
Foliar						
phenylamide/ dithiocarbamate (group 4/M3)	metalaxyl-M/ mancozeb	Ridomil Gold MZ 68WG	2.5 kg	1 kg		Mancozeb, the protectant fungicide in this mixture, should also provide protection against early and late blight. Do not use more than 3 times per year. Provides only erratic suppression of pythium leak. The pythium leak fungus can only penetrate potato tubers through wounds. Metalaxyl-M accumulates in the tuber skin. Tuber wounds allow the *Pythium* fungus to get past the metalaxyl-M barrier and leak develops.
phenylamide + chloronitrile (group 4 + M5)	metalaxyl-M + chlorothalonil	Ridomil Gold + Bravo Twin Pak	208 mL + 2 L	83 mL + 0.8 L		Do not use more than 3 times per year. 48-hr re-entry interval. Do not let tank contents stand for prolonged periods of time without agitation. If spraying is interrupted, thoroughly re-agitate before resuming application.
Post-Harvest						
dithiocarbamate (group M3)	mancozeb	Dithane F-45	1.58 L / 1,000 kg of seed			Apply to seed potatoes only prior to storage to control fusarium dry rot.
inorganic (group M1)	hydrogen peroxide	StorOx	100 mL/ 10 L water			**Fusarium dry rot suppression only.** Apply prior to storage.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	85–175 mL/ tonne of potatoes			See product label for details.

[1] PHI = Pre-Harvest Interval (days).

Table 3–72. Potato — Broad Spectrum Protectant Fungicides
Start spraying prior to row closure.

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
chloronitrile (group M5)	chlorothalonil	Bravo 500	1.2–2.4 L	0.5–1.0 L	1	Use high rate under severe disease pressure. Use higher rates as the crop canopy closes. 48-hr re-entry interval.
dithiocarbamate (group M3)	mancozeb	Manzate Pro-Stick	1.1–2.25 kg	0.4–0.9 kg	1	Use high rate under severe disease pressure. Use higher rates as the crop canopy closes. 24-hr re-entry interval.
		Dithane DG Rainshield				
		Penncozeb 80WP				
	metiram	Polyram DF	1.1–2.25 kg	0.4–0.9 kg	1	24-hr re-entry interval. Use high rate under severe disease pressure. Use higher rates as the crop canopy closes.

[1] PHI = Pre-Harvest Interval (days).

Table 3-73. Early Blight and Late Blight Protectant Fungicides
Begin applications prior to disease development.

Group name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
EARLY BLIGHT ONLY						
QoI (group 11)	azoxystrobin	Quadris Flowable	500–800 mL	200–320 mL	1	Maximum 3 applications/yr. Do not apply sequential applications of any QoI fungicide or of any tank-mix containing a QoI fungicide.
QoI + chloronitrile (group 11+M5)	azoxystrobin + chlorothalonil	Quadris Flowable + Bravo 500	500 mL + 2 L	200 mL + 800 mL	2	Maximum 3 applications/yr. Do not apply sequential applications of any QoI fungicide or of any tank-mix containing a QoI fungicide. 48-hr re-entry interval.
QoI (group 11)	pyraclostrobin	Headline EC	450–670 mL	180–268 mL	3	Rotate with a product from a different fungicide family after every application. 48-hr re-entry interval.
anilino-pyrimidine + chloronitrile (group 9+M5)	pyrimethanil + chlorothalonil	Scala 400 SC + Bravo 500	750 mL + 1.2–2.4 L	300 mL + 0.5–1.0 L	7	Maximum 6 applications/yr. 48-hr re-entry interval.
carboxamide (group 7)	boscalid	Lance WDG/ Cantus WDG	175–315 g	70–126 g	30	Do not apply more than 2 applications before rotating to a different fungicide family. 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	292–512 mL	118–207 mL	14	Apply no more than 2 sequential applications. Maximum 2.04 L/ha per year. 12-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	8–15 L	3–6 L	0	**Suppression only.**
EARLY AND LATE BLIGHT						
QoI + dithiocarbamate (group 11+M3)	fenamidone + mancozeb	Reason 500 SC + Manzate Pro-Stick	200 mL + 1.25 kg	80 mL + 0.5 kg	14	Do not apply sequential applications of any QoI fungicide or of any tank-mix containing a QoI fungicide. 24-hr re-entry interval.
		Reason 500 SC + Dithane DG	200 mL + 1.17 kg	80 mL + 0.47 kg		
		Reason 500 SC + Penncozeb 80 WP	200 mL + 1.17 kg	80 mL + 0.47 kg		
QoI + chloronitrile (group 11+M5)	fenamidone + chlorothalonil	Reason 500 SC + Bravo 500	200 mL + 1.25 L	80 mL + 500 mL		Do not apply sequential applications of any QoI fungicide or of any tank-mix containing a QoI fungicide. 48-hr re-entry interval.
QoI + cyanoacetamide oxime (group 11+27)	famoxadone + cymoxanil	Tanos 50 DF	560–840 g	224–336 g	14	Do not apply sequential applications of any QoI fungicide or of any tank mix containing a QoI fungicide. 24-hr re-entry interval.
QoI + chloronitrile (group 11+M5)	pyraclostrobin + chlorothalonil	Headline EC + Bravo	450–670 mL + 1.2–2.4 L	180–268 mL + 0.5–1.0 L	3	Rotate with a product from a different fungicide family after every application. 48-hr re-entry interval.
QoI + dithiocarbamate (group 11+M3)	pyraclostrobin + metiram	Headline EC + Polyram	450–670 mL + 1.1–1.75 kg	180–268 mL + 440–700 g	3	Rotate with a product from a different fungicide family after every application. 48-hr re-entry interval.

[1] PHI = Pre-Harvest interval (days).

Table 3-74. Late Blight Targeted Protectant Fungicides
Begin applications when weather conditions favour late blight, or if late blight is identified in the local area.

Group name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
carbamate/ chloronitrile (group 28/M5)	propamocarb/ chlorothalonil	Tattoo C	2.7 L	1.1 L	7	Use 200–300 L water/ha (20–30 gal/acre). Maximum 3 applications/yr. 48-hr re-entry interval for hand labour. 4-hr re-entry interval with protection for other short-term tasks not involving hand labour.
carboxylic acid amide (group 40)	mandipropamid	Revus	400–600 L	160–240 L	14	The use of a non-ionic adjuvant (0.25% v/v) is recommended.
cyanoacetamide oxime + dithiocarbamate (group 27+M3)	cymoxanil + mancozeb	Curzate 60 DF + Manzate Pro-Stick	225 g + 1.6 kg	90 g + 0.65 kg	8	Make 2 applications, 5 days apart, then rotate with a late blight targeted protectant fungicide from a different chemical family. 24-hr re-entry interval.
2,6-dinitroanilines (group 29)	fluazinam	Allegro 500F	400 mL	160 mL	14	24-hr re-entry interval. Do not make more than 3 sequential applications.
QiI (group 21)	cyazofamid	Ranman 400SC	100–200 mL	40–80 mL	7	Maximum 6 applications/yr. Do not make sequential applications. 12-hr re-entry interval. 30-day plant-back interval. Use high rate for tuber blight protection.
benzamide/ dithiocarbamate (group 22/M3)	zoxamide/ mancozeb	Gavel 75 DF	1.7–2.25 kg	0.7–0.9 kg	3	Maximum 6 applications/yr. Plant-back restrictions apply, see label for details. 48-hr re-entry interval.
benzamide + chloronitrile (group 43+M5)	fluopicolide + chlorothalonil	Presidio + Bravo 500	220–292 mL + 1.2–2.4 L	91–120 mL + 0.5–1.0 L	7	Maximum 4 applications/yr. Do not make sequential applications 48-hr re-entry interval. See product label for rotational restrictions.
carboxylic acid amides + chloronitrile (group 40+M5)	dimethomorph + chlorothalonil	Acrobat 50 WP + Bravo 500	450 g + 1.2–2.4 L	180 g + 0.5–1.0 L	14	Maximum 3 applications/yr. 120-day plant-back interval. Apply after top kill for tuber blight protection. 48-hr re-entry interval.
carboxylic acid amides + dithiocarbamate (group 40+M3)	dimethomorph + mancozeb	Acrobat 50 WP + Dithane DG	450 g + 1.1–2.25 kg	180 g + 0.4–0.9 kg	14	
	dimethomorph + metiram	Acrobat 50 WP + Polyram	450 g + 1.1–2.25 kg	180 g + 0.4–0.9 kg	14	
LATE BLIGHT TUBER INFECTION PROTECTION						
inorganic (group M1)	copper hydroxide	Kocide 2000	0.8–1.6 kg	0.3–0.6 kg	1	Combine with 1.75–2.25 kg/ha (0.7–0.9 kg/acre) Manzate Pro-Stick. Use 2.4 kg/ha (1 L/acre) at vine kill.
		Parasol Flowable	0.8–1.8 L	0.32–0.7 L	1	
		Coppercide WP	1.1–2.25 kg	0.4–0.9 kg	1	Combine with 1.75–2.25 kg /ha (0.7–0.9 kg/acre) of a mancozeb product. May be applied at vine kill with a dessicant or alone after vine kill, prior to harvest at the rate of 3.4 kg/ha (1.4 kg/acre).
	copper sulphate	Copper 53W	5.5 kg	2.2 kg	1	Copper sulphate can cause phytotoxicity, especially under hot and humid conditions. Apply close to vine killing time to kill spores of the late blight fungus.
	copper oxychloride	Copper spray	4 kg	1.6 kg	1	

[1] PHI = Pre-Harvest Interval (days).

Table 3–75. Colorado Potato Beetle Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Comments
Soil Treatments						
neonicotinoid (group 4A)	imidacloprid	Admire 240 F[2]	0.85–1.3 L (90-cm row spacing)	0.34–0.53 L (90-cm row spacing)		Use 7.5–12 mL per 100 m of row. For best results, spray directly on the seed piece.
		Grapple$_2$[2]				
	thiamethoxam	Actara 240 SC[2]	378–488.9 mL (90-cm row spacing)	153–197.9 mL (90-cm row spacing)	90	Will also control leafhoppers. Maximum 2 applications per year. Do not use in fields where any neonicotinoid insecticide was used as a seed treatment or soil application. 12-hr re-entry interval.
	clothianidin	Clutch 50 WDG[2]	266–448 g	108–181 g		
Foliar Sprays						
biological (group 11)	*Bacillus thuringiensis*	Novodor	5.0–8.0 L	2–3.2 L	1	**For 1st and early 2nd instar Colorado beetle larvae only;** other stages and other insects not controlled. Field scouting is essential for timing the sprays.
spinosyn (group 5)	spinetoram	Delegate WG	160–240 g	65–97 g		**Time the application for egg hatch or small larvae.** Scout fields 3 days after the first application, a repeat application might be necessary. Will also control **European Corn Borer** (160 g/ha).
neonicotinoid (group 4A)	imidacloprid	Admire 240 F	200 mL	81 mL	7	Maximum 2 foliar applications/yr. 24-hr re-entry interval.
		Grapple$_2$				
	acetamiprid	Assail 70 WP	40–80 g	16–32 g	7	Maximum 2 applications/yr. 12-hr re-entry interval.
	clothianidin	Clutch 50 WDG	70–105 g	28–42 g	14	
	thiamethoxam	Actara 25WG	105 g	42 g	7	Will also control leafhoppers. Maximum 2 applications/yr. 12-hr re-entry interval.
		Actara 240 SC	109 mL	44 mL		
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–151 mL		Early applications on larval stages provide best control. Will also control European corn borer. 12-hr re-entry interval.
spinosyn (group 5)	spinosad	Success 480 SC	166 mL	67 mL	7	Will also control European corn borer. Maximum 240 mL of product per year. 12-hr re-entry interval.
		Entrust 80W	50–100 g	20–40 g	7	Will also control European corn borer (small larvae). Maximum 2 applications/yr. Maintain a spray pH of 6 or greater. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Do not apply a foliar neonicotinoid spray in fields where a neonicotinoid was used either in-furrow or as a seed treatment. See *Caution*, on page 94.
[3] Registration expires on December 31, 2012.
[4] Registration expires on December 31, 2013.
[5] Registration expires on July 1, 2013.

Table 3-75. Colorado Potato Beetle Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Comments
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83–125 mL	34–51 mL	7	Use the higher rate for larger instars and infestations. Maximum 3 applications/yr at the low rate or 2 applications/yr at the high rate. Do not exceed 250 mL/ha (100 mL/acre) per yr. 24-hr re-entry interval.
		Silencer 120 EC				
	cypermethrin	Ripcord 400 EC	62.5–125 mL	25.3–51 mL	7	
		UP-Cyde 2.5 EC	140 mL	57 mL	7	12-hr re-entry interval.
	permethrin	Perm-UP	180–260 mL	73–105 mL	7	12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 50 WP[3]	1.0–1.5 kg	0.4–0.6 kg	5	5-day re-entry interval.
		Thiodan 4EC[4]	1.5–2.0 L	0.6–0.8 L	5	
		Thionex 50 WP[5]	1.1–1.5 kg	0.4–0.6 kg	5	
carbamate (group 1A)	oxamyl	Vydate L	2.3–3.0 L	0.9–1.2 L	7	24-hr re-entry interval.
organophosphate (group 1B)	naled	Dibrom	1.1 L	0.4 L	4	48-hr re-entry interval.
benzoylurea (group 15)	novaluron	Rimon 10 EC	410–820 mL	166–332 mL	14	Maximum 2 applications/yr. Apply at egg hatch to second instar. Also controls European corn borer (small larvae).

[1] PHI = Pre-Harvest Interval (days).
[2] Do not apply a foliar neonicotinoid spray in fields where a neonicotinoid was used either in-furrow or as a seed treatment. See *Caution*, on page 94.
[3] Registration expires on December 31, 2012.
[4] Registration expires on December 31, 2013.
[5] Registration expires on July 1, 2013.

Caution

The Colorado Potato beetle (CPB) has the ability to develop resistance to insecticides very rapidly. Several insecticides for CPB control belong to the neonicotinoid chemical family. To delay the development of resistance to neonicotinoids, the following practices are strongly suggested:

Do not apply a neonicotinoid foliar spray in fields where a neonicotinoid was used either in-furrow or as a seed treatment.

- Use label rates.
- Scout fields regularly to evaluate the efficacy of insecticide treatments.
- If control of CPB is poor after an insecticide application, collect CPB samples and have them tested for resistance.

CPB has developed resistance to most of the pyrethroid insecticides. Conduct a backpack spray test in a small area of the field before applying a pyrethroid to the entire field.

Table 3–76. Potato Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Comments
POTATO LEAFHOPPER, FLEA BEETLE, TARNISHED PLANT BUG						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	7	Also controls European corn borer. Maximum 3 ground applications or 2 aerial applications/yr. 24-hr re-entry interval.
		Silencer 120 EC				
	deltamethrin	Decis 5 EC	100–150 mL	40–61 mL	3	Maximum 3 applications/yr.
	permethrin	Pounce 384EC	180–260 mL	73–105 mL	1	
		Perm-UP				
		Ambush 500 EC	140–200 mL	57–81 mL		Use higher rate for heavy infestations. Also controls European corn borer. 12-hr re-entry interval.
	cypermethrin	Ripcord 400 EC	62.5–125 mL	25.3–51 mL	7	Use high rate on tarnished plant bug.
		UP-Cyde 2.5 EC	140 mL	57 mL	7	Use 200 mL/ha or 40 mL/acre for tarnished plant bug. 12-hr re-entry interval.
organophosphate (group 1B)	dimethoate	Lagon 480	0.55–1.1 L	0.22–0.4 L	7	**Leafhoppers only.**
		Cygon 480				
	naled	Dibrom	1.1 L	0.4 L	4	Not for tarnished plant bug. 48-hr re-entry interval.
	acephate	Orthene 75 SP	0.75–1.1 kg	0.3–0.4 kg	21	Maximum 4 applications/yr. 24-hr re-entry interval.
	chlorpyrifos	Lorsban 4E	1.0 L	0.4 L	7	Not for leafhopper. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E	1.0 L	0.4 L	7	Not for leafhoppers. 24-hr re-entry interval.
carbamate (group 1A)	oxamyl	Vydate L	2.3–3.0 L	0.9–1.2 L	7	24-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 50 WP[2]	1.0–1.5 kg	0.4–0.6 kg	5	5-day re-entry interval.
		Thiodan 4EC[3]	1.5–2.0 L	0.6–0.8 L	5	
		Thionex 50 WP[4]	1.1–1.75 kg	0.4–0.7 kg	5	
Not Classified	kaolin	Surround WP	6.25–12.5 kg	2.5–5.1 kg		**For suppression of leafhoppers only.** For early applications, use the higher labelled rate per 250 L of water; follow-up applications may only require the lower labelled rate per 250 L of water.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Registration expires on December 31, 2013.
[4] Registration expires on July 1, 2013.

Table 3-76. Potato Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Comments
LATE-SEASON CUTWORMS						
pyrethroid (group 4A)	cypermethrin	Ripcord 400 EC	175 mL	70 mL	7	
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.5–1 L	7	Apply in early evening for maximum control. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				
	permethrin	Ambush 500EC	140–200 mL	57–81 mL	1	**Variegated cutworm.** Use high rate on dry soils or large larvae. Apply up to 5-leaf stage. Do not disturb ground for 5 days following application. 12-hr re-entry interval.
		Perm-UP	180 mL	73 mL		
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–151 mL	1	**Variegated cutworm.** Maximum 4 applications per year. 12-hr re-entry interval.
SPIDER MITES						
avermectins (group 6)	abamectin	Agri-Mek 1.9% EC	1 L	404 mL	14	Apply in 185 L of water/ha or 74 L of water/acre. Apply when spider mites first appear.
WIREWORMS						
organophosphate (group 1B)	phorate	Thimet 15-G	15.6–23.9 kg (90-cm row spacing)	6.31–9.67 kg (90-cm row spacing)		Due to soil adaptation, repeated annual applications of phorate (Thimet 15-G) to the same soil may result in significantly reduced insecticide persistence in the second and subsequent years of application. Do not use it on varieties that will be harvested in less than 90 days after planting.

[1] PHI = Pre-Harvest Interval (days).
[2] Registration expires on December 31, 2012.
[3] Registration expires on December 31, 2013.
[4] Registration expires on July 1, 2013.

Table 3-77. Potato Crop Aphid Control

Group name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Comments
Soil Application						
neonicotinoid[2] (group 4A)	imidacloprid	Admire 240 F Alias 240 EC Grapple$_2$	0.85–1.3 L (90-cm row spacing)	0.34–0.5 L (90-cm row spacing)	7	Also controls leafhoppers and fleabeetles. 24-hr re-entry interval.
	thiamethoxam	Actara 240SC	378–488.9 mL (90-cm row spacing)	153–198 mL (90-cm row spacing)	90	Also controls leafhoppers. Maximum 1 application/yr.
Foliar Applications						
pymetrozine (group 9B)	pymetrozine	Fulfill 50WG[3]	193 g	78 g	14	12-hr re-entry interval. Maximum 2 applications/yr.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	0.12–0.16 kg	0.05–0.06 kg	7	12-hr re-entry interval.
neonicotinoid[2] (group 4A)	imidacloprid	Admire 240 F Alias 240 EC Grapple$_2$	200 mL	81 mL	7	Maximum 2 applications/yr for all uses. 24-hr re-entry interval.
	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	Do not make more than 2 applications/yr. 12-hr re-entry interval.
	thiamethoxam	Actara 240SC	109 mL	44.1 mL	7	Also controls leafhoppers. Maximum 2 applications/yr. 12-hr re-entry interval.
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	7	Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
organophosphate (group 1B)	dimethoate	Cygon 480 Lagon 480	0.55–1.1 L	0.22–0.4 L	7	
	methamidophos	Monitor 480[4]	1.75–2.25 L	0.7–0.9 L	14	Also controls leafhoppers, tarnished plant bugs and flea beetles. It can be effective against Colorado potato beetle in areas where this insect has not developed resistance to this insecticide yet. 48-hr re-entry interval.
	acephate	Orthene 75 SP	0.75–1.1 kg	0.3–0.4 kg	21	**Green peach and potato aphids only.** Maximum 4 applications/yr. 12-hr re-entry interval.
	oxamyl	Vydate L	2.3–3.0 L	0.9–1.2 L	7	**Green peach and potato aphids only.** 24-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Do not apply a neonicotinoid foliar spray in fields where a neonicotinoid was used either in-furrow or as a seed treatment.
[3] Fulfill 50WG causes cessation of aphid feeding shortly after application. However, aphids may remain on the plant for 2–4 days before they die.
[4] Registration expires on December 31, 2012.

RADISHES

Seed treatments registered on radishes are listed in Table 3–78, *Radish Seed Treatments*. Activities of products for radish diseases are listed in Table 3–79, *Activity of Fungicides on Radish Diseases*. Activities of products for radish insects are listed in Table 3–80, *Activity of Insecticides on Radish Insects*. Products registered for radish diseases and insects are listed in Table 3–81, *Radish Disease and Insect Control*.

Table 3–78. Radish Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	**For use in commercial seed-treatment plants only.**
Thiram 75 WP	thiram	90 g/ 25 kg seed	seed decay and damping-off	Seed box treatment.
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping off (*Rhizoctonia*)	**For import use only.** Not for domestic commercial or on-farm seed treatment.

Table 3–79. Activity of Fungicides on Radish Diseases

Common Name	Trade Name	Damping-Off	Alternaria	Powdery Mildew	Downy Mildew	Rhizoctonia Root Rot, Crown Rot, Stem Canker	Botrytis Grey Mould
metalaxyl-M	Apron XL LS	✔					
thiram	Thiram 75 WP	✔					
azoxystrobin	Dynasty 100FS	✔					
pyraclostrobin	Cabrio EG		✔	✔			
metalaxyl-M	Ridomil Gold 480SL				+		
azoxystrobin	Quadris Flowable					✔	
cyprodinil/ fludioxonil	Switch 62.5 WG						✔

✔ = control + = suppression blank cell = not registered for control of this pest

Table 3–80. Activity of Insecticides on Radish Insects

Common Name	Trade Name	Cabbage Maggot	Flea Beetles	Aphids	Cabbage Looper	Imported Cabbageworm	Diamondback Moth
chlorpyrifos	Lorsban 4E	✔					
	Pyrinex 480 EC	✔					
	Nufos 4E	✔					
permethrin	Pounce 384EC		✔				
	Perm-UP		✔				
	Ambush 500EC		✔				
carbaryl	Sevin XLR		✔			✔	✔
flonicamid	Beleaf 50SG			✔			
diazinon	Diazinion 50 W		✔	(✔)			
malathion	Malathion 85E		✔	(✔)			
spinosad	Success 480 SC				✔	✔	✔
	Entrust 80 W				✔	✔	✔
spinetoram	Delegate WG				✔	✔	✔
Bacillus thuringiensis	Dipel 2X DF				✔	✔	✔

✔ = control (✔) = registered but not considered effective or resistance is documented blank cell = not registered for control of this pest

Table 3-81. Radish Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ALTERNARIA, POWDERY MILDEW						
QoI (group 11)	pyraclostrobin	Cabrio EG	0.56–1.1 kg	226–445 g	3	12-hr re-entry interval. 72-hr re-entry interval for hand harvesting.
DOWNY MILDEW						
phenylamides (group 4)	metalaxyl-M	Ridomil Gold 480SL	1.2–2.4 L	0.5–1 L	21	**Suppression. Do not apply after planting.** Maximum 1 application/yr. Apply by broadcast or banding (18 cm) before or at-planting. Apply in sufficient water to provide coverage of soil. 12-hr re-entry interval.
RHIZOCTONIA — ROOT ROT, CROWN ROT, STEM CANKER						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	15	**Radish.** Maximum 1 application/yr; applied in-furrow at planting or banded soon after emergence.
					40	**Daikon.** Maximum 1 application/yr; applied in-furrow at planting or banded soon after emergence.
CABBAGE MAGGOT						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E Pyrinex 480 EC Nufos 4E	85 mL in 380 L water/ 1,000 m of row	26 mL in 30 gal water/ 1,000 ft of row	21	**Radish.** Apply as a drench at time of seeding. 24-hr re-entry interval.
			210 mL in 1,000 L water/ 1,000 m of row	63 mL in 79 gal water/ 1,000 ft of row	32	**Asian radish (lo bok, daikon).** Apply as a drench at 7, 20 and 35 days after seeding. 24-hr re-entry interval.
FLEA BEETLES						
pyrethroid (group 3A)	permethrin	Pounce 384EC	180 mL	73 mL	2	12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140 mL	57 mL	2	
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1 L	7	
APHIDS						
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	3	Thorough spray coverage is essential for optimum control. Use higher rates for greater pest populations and/or dense foliage. 12-hr re-entry interval.
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1 kg	0.4 kg	10	Control of aphids with these products has been inconsistent in many areas.
	malathion	Malathion 85E	535–1,345 mL	216–544 mL	7	
CABBAGE LOOPER, IMPORTED CABBAGEWORM, DIAMONDBACK MOTH						
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	74 mL	3	Maintain a spray pH of 6 or higher.
		Entrust 80 W	109 g	44 g	3	
	spinetoram	Delegate WG	140–200 g	57–81 g	3	**Radish and Oriental radish.** Use the higher rate for high infestations or advanced growth stages of the target pest.
biological (group 11)	*Bacillus thuringiensis*	Dipel 2X DF	55–550 g	22–223 g	0	**Asian radish (lo bok, daikon) only.** Use 275–550 g/ha (111–223 g/acre) for loopers.

[1] PHI = Pre-Harvest Interval (days).

RHUBARB

Products registered for rhubarb insects are listed in Table 3–82, *Rhubarb Insect Control.*

Table 3–82. Rhubarb Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
APHIDS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	12-hr re-entry interval. Use high rate under heavy pest pressure.
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	3	Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with an adjuvant/additive having spreading and penetrating properties. See label for further detail. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	48–65 g	0	Use high rate for heavy infestations. 12-hr re-entry interval.
POTATO STEM BORER AND CABBAGE LOOPER						
spinosyn (group 5)	spinosad	Entrust 80W	109 g	44 g	1	**Potato Stem Borer.** Maintain a spray pH of 6 or higher.
		Success 480 SC	182 mL	74 mL	1	
	spinetoram	Delegate WG	140–200 g	57–81 g	1	**Cabbage Looper.** Use the high rate for heavy infestations or large larvae. 12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	**Cabbage Looper.** 12-hr re-entry interval.
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10–20 kg	0	Use higher rates on severe infestations.

[1] PHI = Pre-Harvest Interval (days).

RUTABAGAS

Seed treatments registered on rutabagas are listed in Table 3–83, *Rutabaga Seed Treatments*. Activities of products for rutabaga diseases are listed in Table 3–84, *Activity of Fungicides on Rutabaga Diseases*. Products registered for rutabaga diseases are listed in Table 3–85, *Rutabaga Disease Control*.

Activities of products for rutabaga insects are listed in Table 3–86, *Activity of Insecticides on Rutabaga Insects*. Products registered for rutabaga insects are listed in Table 3–87, *Rutabaga Insect Control*.

Table 3–83. Rutabaga Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	**For use in commercial seed-treatment plants only.**
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping off (*Rhizoctonia*)	**For import use only.** Not for domestic commercial or on-farm seed treatment.

Table 3–84. Activity of Fungicides on Rutabaga Diseases

Common Name	Trade Name	Damping-Off	Downy Mildew	Powdery Mildew	Rhizoctonia	Botrytis Grey Mould
metalaxyl-M	Apron XL LS	✔				
azoxystrobin	Dynasty 100FS	✔				
fosetyl-al	Aliette WDG		✔			
fluopicolide + fosetyl-al	Presidio + Aliette WDG		✔			
pyraclostrobin	Cabrio EG			✔		
propiconazole	Topas 250E			✔		
	Mission 418 EC			✔		
sulphur	Microscopic Sulphur			✔		
azoxystrobin	Quadris Flowable				✔	
cyprodinil/ fludioxonil	Switch 62.5 WG					✔

✔ = control
blank cell = not registered for control of this pest

Table 3-85. Rutabaga Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
MOSAIC VIRUS						
Not Classified	mineral oil	Superior 70 Oil	11 L in 550–1,100 L of water	4.4 L in 50–100 gal of water	21	Do not apply mineral oil in direct sunlight. **Aphid feeding deterrent only.** 12-hr re-entry interval.
DOWNY MILDEW						
phosphonate (group 33)	fosetyl-al	Aliette WDG	2.25–3.12 kg in minimum 100 L water	0.9–1.25 kg in minimum 10 gal water	7	Spray at 7-day intervals as required. 12-hr re-entry interval.
benzamides + phosphonate (group 43+33)	fluopicolide + fosetyl-al	Presidio + Aliette WDG	220–292 mL + 2.25–3.12 kg	89–118 mL + 0.9–1.25 kg	7	Do not make sequential applications. See product label for rotational restrictions. 12-hr re-entry interval.
POWDERY MILDEW						
QoI (group 11)	pyraclostrobin	Cabrio EG	0.56–0.84 kg	0.23–0.34 kg	3	Do not use more than 2 applications before rotating to a different fungicide group. 3-day re-entry interval for hand thinning activities.
DMI (group 3)	propiconazole	Topas 250E	400 mL in minimum 200 L water	160 mL in minimum 18 gal water	21	A second application may be made 20 days after the first.
		Mission 418 EC	240 mL in minimum 200 L water	96 mL in minimum 18 gal water	21	Make 2 applications/yr: the 1st application 50 days after planting and the 2nd application 20 days later.
inorganic (group M1)	sulphur	Microscopic Sulphur	6.8 kg in 675–1,125 L water	2.75 kg in 60–100 gal water	0	This product is not compatible with Superior Oil. 24-hr re-entry interval.
RHIZOCTONIA						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	40	Maximum 1 application/yr; applied in-furrow at planting or banded soon after emergence.

[1] PHI = Pre-Harvest Interval (days).

Table 3-86. Activity of Insecticides on Rutabaga Insects

Common Name	Trade Name	Cabbage Maggot	Flea Beetles	Leaf-Eating Caterpillars	Cutworms	Aphids
chlorpyrifos	Lorsban 15G	✔				
	Lorsban 4E	✔			✔	
	Pyrinex 480 EC	✔			✔	
	Nufos 4E	✔			✔	
cypermethrin	Ripcord 400 EC		✔			
	Up-Cyde 2.5 EC		✔			
carbaryl	Sevin XLR		✔	✔		
endosulfan	Thiodan 4EC		✔	✔		✔
spinosad	Success 480 SC			✔		
	Entrust 80 W			✔		
spinetoram	Delegate WG			✔		
flonicamid	Beleaf 50SG					✔

✔ = control
blank cell = not registered for control of this pest

Table 3-87. Rutabaga Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CABBAGE ROOT MAGGOT						
Treatment at Planting						
organophosphate (group 1B)	chlorpyrifos	Lorsban 15G	0.6–1 kg/ 1,000 m of row	0.18–0.3 kg/ 1,000 ft of row	30	24-hr re-entry interval.
Treatment After Planting						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E Nufos 4E	210 mL/ 1,000 m of row (in 125 L of water)	64 mL/ 1,000 ft of row (in 11 gal of water)	30	Apply on soil, 10 cm (4 in.) on each side of the plant, 10, 28, 49 and 70 days after seeding. 24-hr re-entry interval.
FLEA BEETLES						
pyrethroid (group 3A)	cypermethrin	Ripcord 400 EC	123 mL	49 mL	21	
		UP-Cyde 2.5 EC	200 mL	81 mL	21	12-hr re-entry interval.
carbamate (group 1A)	carbaryl	Sevin XLR	1.25–2.5 L	0.5–1.0 L	7	
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	2.0 L	0.8 L	45	48-hr re-entry interval.
LEAF-EATING CATERPILLARS						
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	73 mL	3	Maintain a spray pH of 6 or higher. 72-hr re-entry for hand-thinning.
		Entrust 80 W	109 g	44 g	3	
	spinetoram	Delegate WG	140–200 g	56–80 g	3	Use the higher rate for high infestations or advanced growth stages of the target pest. 12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	2.0 L	0.8 L	45	48-hr re-entry interval.
CUTWORMS						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E Pyrinex 480 EC Nufos 4E	1.2–2.4 L in 200–400 L water	0.5–1.0 L in 20–40 gal water	30	May be used at the rate of 2.4 L/ha (1.0 L/acre) as a preplanting treatment. Apply once at seedling stage (2–5 leaves), when damage first appears. 24-hr re-entry interval.
APHIDS						
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	3	Thorough spray coverage is essential for optimum control. Use higher rates for greater pest populations and/or dense foliage. 12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[2]	2.0 L	0.8 L	45	48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).
[2] Last date of use is December 31, 2012.

SPINACH & SWISS CHARD

Seed treatments registered on spinach and Swiss chard are listed in Table 3–88, *Spinach and Swiss Chard Seed Treatments.* Activities of products for spinach and Swiss chard diseases and insects are listed in Table 3–89, *Activity of Fungicides and Insecticides on Spinach and Swiss Chard Diseases and Insects.* Products registered for spinach and Swiss chard diseases are listed in Table 3–90, *Spinach and Swiss Chard Disease Control.* Products registered for spinach and Swiss chard insects are listed in Table 3–91, *Spinach and Swiss Chard Insect Control.*

Table 3–88. Spinach and Swiss Chard Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	damping-off (*Pythium*)	**For use in commercial seed-treatment plants only.** Not for greenhouse-grown spinach.
Thiram 75 WP	thiram	90 g/ 25 kg seed	seed decay and damping-off	Seed box treatment.
Dynasty 100FS	azoxystrobin	25–50 mL/ 100 kg seed	damping-off (*Rhizoctonia solani*)	**For import use only. Spinach and Swiss chard.** Not for domestic commercial or on-farm seed treatment.

Table 3–89. Activity of Fungicides and Insecticides on Spinach and Swiss Chard Diseases and Insects

Common Name	Trade Name	Damping-Off	Downy Mildew	White Rust	Leafminers	Aphids	Cabbage Looper
metalaxyl-M	Apron XL LS	✔					
thiram	Thiram 75 WP	✔					
azoxystrobin	Dynasty 100FS	✔					
	Quadris Flowable		✔				
mandipropamid	Revus		✔				
metalaxyl-M	Ridomil Gold 480SL		✔				
pyraclostrobin/ boscalid	Pristine WG		+				
Bacillus subtilis	Serenade ASO			+			
acetamiprid	Assail 70 WP				–	✔	
thiamethoxam	Actara 25WG					✔	
cyromazine	Citation 75WP				✔		
chlorantraniliprole	Coragen				✔		✔
diazinon	Diazinon 50 W				✔	(✔)	
malathion	Malathion 25W				✔	✔	
spirotetramat	Movento 240 SC					✔	
flonicamid	Beleaf 50SG					✔	
dimethoate	Cygon 480					✔	
	Lagon 480					✔	
naled	Dibrom					(✔)	✔
Bacillus thuringiensis	Thuricide-HPC						✔
	Dipel 2X DF						✔
	Bioprotec CAF						✔
spinosad	Success 480 SC						✔
	Entrust 80 W						✔
spinetoram	Delegate WG						✔

✔ = control
\+ = suppression
– = reduction in damage
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

Table 3-90. Spinach and Swiss Chard Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
DOWNY MILDEW						
QoI (group 11)	azoxystrobin	Quadris Flowable	1.125 L	455 mL	7	**Spinach only.** Begin applications prior to disease development.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	161–243 mL	1	The use of a non-ionic adjuvant (0.25% v/v) is recommended. 12-hr re-entry interval.
phenylamide (group 4)	metalaxyl-M	Ridomil Gold 480SL	1 L	0.4 L		**Spinach only.** Pre-plant incorporated application; apply at planting as a banded application over row. 12-hr re-entry interval.
SDHI/QoI (group 7/11)	pyraclostrobin/ boscalid	Pristine WG	1.6 kg	0.6 kg	0	**Suppression only.** 24-hr re-entry interval. 9-day for hand harvesting and thinning.
WHITE RUST						
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	4–8 L	1.6–3.2 L	0	**Suppression only.** Begin applications when conditions become conducive for disease development. Repeat at 7–10-day intervals.

[1] PHI = Pre-Harvest Interval (days).

Table 3-91. Spinach and Swiss Chard Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
LEAFMINERS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	86 g	35 g	7	Alternate applications with different insecticide groups. 12-hr re-entry interval.
cyromazine (group 17)	cyromazine	Citation 75WP	188 g in 200 L water	76 g in 18 gal water	7	12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	**Vegetable and serpentine leafminers only.** 12-hr re-entry interval.
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1 kg	0.4 kg	10	**Spinach only.**
	malathion	Malathion 25W	5.5–7 kg	2.2–2.8 kg	7	
APHIDS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	Alternate applications with different insecticide groups. 12-hr re-entry interval.
	thiamethoxam	Actara 25WG	105 g	43 g	7	Apply in sufficient water volume to ensure adequate coverage. Use at least 100 L of water/ha. Also effective at reducing damage by tarnished plant bug at 210 g/ha. 12-hr re-entry interval.
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	3	Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with spray adjuvant/additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50SG	120–160 g	49–65 g	0	Use higher rates for high pest populations or dense foliage. 12-hr re-entry interval.
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1 kg	0.4 kg	10	**Spinach only.** Control of aphids with diazinon has been inconsistent in many areas.
		Diazinon 50 W	1.1 kg	0.4 kg	14	**Swiss chard.** Control of aphids with diazinon has been inconsistent in many areas.
	dimethoate	Cygon 480	700 mL	283 mL	7	**Swiss chard only.**
		Lagon 480				
	naled	Dibrom	1.1–1.65 L	0.4–0.7 L	4	**Spinach only.** Control of aphids with naled has been inconsistent in many areas. 48-hr re-entry interval.
CABBAGE LOOPER						
biological (group 11)	*Bacillus thuringiensis*	Thuricide-HPC	2–4.25 L	0.8–1.72 L	0	**Spinach only.**
		Dipel 2X DF	275–550 g	111–223 g	0	
		Bioprotec CAF	1.4–2.8 L	0.6–1.1 L	0	
spinosyn (group 5)	spinosad	Success 480 SC	182 mL	74 mL	1	Maintain a spray pH of 6 or higher.
		Entrust 80 W	109 g	44 g	1	
	spinetoram	Delegate WG	140–200 g	57–81 g	1	12-hr re-entry interval.
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	12-hr re-entry interval.
organophosphate (group 1B)	naled	Dibrom	1.1–1.65 L	0.4–0.7 L	4	**Spinach only.** 48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

SUGARBEETS

Seed treatments registered on sugarbeets are listed in Table 3–92, *Sugarbeet Seed Treatments.* Activities of products for sugarbeet diseases are listed in Table 3–93, *Activity of Fungicides on Sugarbeet Diseases.* Products registered for sugarbeet diseases are listed in Table 3–94, *Sugarbeet Disease Control.*

Activities of products for sugarbeet insects are listed in Table 3–95, *Activity of Insecticides on Sugarbeet Insects.* Products registered for sugarbeet insects are listed in Table 3–96, *Sugarbeet Insect Control.*

Table 3–92. Sugarbeet Seed Treatments

Trade Name	Active Ingredients	Rate	Pests Controlled	Notes
Apron XL LS	metalaxyl-M	20–40 mL/ 100 kg seed	pythium damping-off	**Apply using commercial seed treatment equipment only.**
Allegiance FL	metalaxyl	93 mL/ 100 kg seed	pythium seed rot, seedling blight	**For application by commercial seed treaters only.**
Maxim 480FS	fludioxonil	5.2–10.4 mL/ 100 kg seed	seed- and soil-borne diseases (*Fusarium, Rhizoctonia, Aspergillus, Penicillium*)	**For import use only.** Not for domestic commercial or on-farm seed treatment.
Thiram 75 WP	thiram	90 g/ 25 kg seed	seed decay, seedling blight, damping-off	Do not graze or feed treated clippings to livestock.
Cruiser 5FS	thiamethoxam	50–100 mL/ 100,000 seeds	wireworm	**For import use only.** Not for domestic commercial or on-farm seed treatment.

Table 3–93. Activity of Fungicides on Sugarbeet Diseases

Common Name	Trade Name	Cercospora Leaf Spot	Rhizoctonia Root and Crown Rot	Powdery Mildew
thiophanate-methyl	Senator 70WP	✔		
pyraclostrobin	Headline EC	✔		
prothioconazole	Proline	✔	✔	
difenoconazole	Inspire	✔		✔
mancozeb	Manzate Pro-Stick	✔		
	Penncozeb 80WP	✔		
metiram	Polyram DF	✔		
copper hydroxide	Parasol WP	✔		
	Coppercide WP	✔		
azoxystrobin	Quadris Flowable		✔	

✔ = control
blank cell = not registered for control of this pest

Table 3-94. Sugarbeet Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CERCOSPORA LEAFSPOT						
methyl-benzimidazole carbamates (group 1)	thiophanate-methyl	Senator 70WP	420–560 g	170–227 g	21	**Systemic.** Always rotate with a different fungicide group. Follow an IPM and resistance management strategy. **For sugarbeets grown for export use only.** Do not feed any part of treated plants to livestock.
QoI (group 11)	pyraclostrobin	Headline EC	670–900 mL	271–364 mL	7	**Systemic.** Use high rate when disease pressure is high. Always rotate with a different fungicide group. 12-hr re-entry interval.
DMI (group 3)	prothioconazole	Proline	315–415 mL	127–168 mL	7	Alternate with a non-triazole (non-group 3) fungicide. 24-hr re-entry interval.
	difenoconazole	Inspire	292–512 mL	118–207 mL	14	Alternate with a non-triazole (non-group 3) fungicide. 12-hr re-entry interval.
dithiocarbamate (group M3)	mancozeb	Manzate Pro-Stick	2.25 kg	0.9 kg	21	Apply every 7–10 days. Do not use treated beet tops for feed. 24-hr re-entry interval.
		Penncozeb 80WP				
	metiram	Polyram DF	2.25 kg	0.9 kg	21	Apply at 7–10-day intervals. Do not use treated beet tops for feed.
inorganic (group M1)	copper hydroxide	Parasol WP	2.25–4.5 kg	0.9–1.8 kg	1	Apply at 10–14-day intervals once disease is detected. Add suitable non-herbicidal agricultural oil at 5.5 L/ha. 48-hr re-entry interval.
		Coppercide WP				
RHIZOCTONIA ROOT AND CROWN ROT						
QoI (group 11)	azoxystrobin	Quadris Flowable	4–6 mL/ 100 m of row	1.2–1.8 mL/ 100 ft of row	100	In-furrow application. Make only 1 application/yr.
			0.5–1.1 L	0.2–0.45 L	100	Banded over the row before the 6th-leaf stage. Do not apply over the row if Quadris has previously been applied in-furrow.
POWDERY MILDEW						
QoI (group 11)	pyraclostrobin	Headline EC	670–900 mL	271–364 mL	7	Use high rate when disease pressure is high. Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
DMI (group 3)	difenoconazole	Inspire	292–512 mL	118–207 mL	14	Alternate with a non-triazole (non-group 3) fungicide. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

Table 3–95. Activity of Insecticides on Sugarbeet Insects

Common Name	Trade Name	Stink Bugs	Lygus Bugs	Flea Beetles	Cutworms	Aphids	Leafhoppers	Spider Mites	Wireworms
terbufos	Counter 15 G								✔
chlorpyrifos	Lorsban 4E				✔				
permethrin	Ambush 500EC				✔				
	Perm-UP				✔				
malathion	Malathion 85E			✔					
naled	Dibrom						✔	✔	
permethrin	Pounce 384EC				✔				
carbaryl	Sevin XLR	(✔)	✔	✔			✔		
endosulfan	Thiodan 4EC[1]					✔			

✔ = control
(✔) = registered but not considered effective or resistance is documented
blank cell = not registered for control of this pest

[1] Registration expires on December 31, 2013.

Table 3–96. Sugarbeet Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
WIREWORM						
organophosphate (group 1B)	terbufos	Counter 15 G	45 g/ 100 m of row	13.7 g/ 100 ft of row	120–150	Apply in-furrow at planting. Do not place in direct contact with seed. Rates based on minimum 50-cm (20-in.) spacing. 48-hr re-entry interval.
CUTWORMS						
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.5–1.0 L	90	24-hr re-entry interval.
pyrethroid (group 3A)	permethrin	Ambush 500EC	140–300 mL	57–121 mL		Apply in the late evening or at night. Do not disturb the soil for 5 days after application. Use high rates on dry or muck soils or on large larvae. 12-hr re-entry interval.
		Perm-UP	180–390 mL	73–158 mL		
FLEA BEETLES, LEAFHOPPERS, SPIDER MITE						
organophosphate (group 1B)	malathion	Malathion 85E	535 mL	217 mL		**Flea beetles only.**
	naled	Dibrom	2.2 L	0.9 L	5	**Red spider mites, leafhoppers only.** 48-hr re-entry interval.

[1] PHI = Pre-harvest Interval (days).

SWEET CORN

Seed treatments registered on sweet corn are listed in Table 3–97, *Sweet Corn Seed Treatments*. Activities of products for sweet corn diseases are listed in Table 3–98, *Activity of Fungicides on Sweet Corn Diseases*. Products registered for sweet corn diseases are listed in Table 3–99, *Sweet Corn Disease Control*.

Activities of products for sweet corn insects are listed in Table 3–100, *Activity of Insecticides on Sweet Corn Insects*. Products registered for sweet corn insects are listed in Table 3–101, *Sweet Corn Insect Control*.

Table 3-97. Sweet Corn Seed Treatments

		Insects				Seedling Blights[1]				
Active Ingredient(s)	**Trade Name**	Seedcorn Maggots	Wireworm	White Grubs	Flea Beetles	Penicillium	Pythium	Fusarium	Rhizoctonia	**Notes**
thiamethoxam + fludioxonil + metalaxyl-M	Cruiser 5 FS + Maxim 480FS + Apron XL LS	✔	✔	✔	✔	✔	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product labels for rates. Request the high rate for wireworm and white grub control and where the field has a history of pest pressure.
thiamethoxam + fludioxonil + azoxystrobin	Cruiser 5 FS + Maxim XL + Dynasty 100FS	✔	✔	✔	✔	✔	✔	✔	✔	
diazinon/captan/ thiothanate-methyl	DCT	✔				✔	✔	✔	✔	Seed box treatment. Use 125 g/25 kg of seed.
diazinon/ captan	Agrox B-2	✔					✔	✔	✔	Seed box or slurry treatment. Use 85 g/25 kg of seed. Do not use on seed previously treated with an insecticide. Use within 1 month of treatment.
	Agrox CD	✔					✔	✔	✔	Seed box treatment. Use 50 g/25 kg of seed. Do not use on seed previously treated with an insecticide. Use on seed previously treated with captan or thiram.
difenoconazole/ metalaxyl-M	Dividend XL RTA					✔	✔	✔		**For use in commercial or on-farm seed treatment equipment only.** Use 325 mL per 100 kg of seed. Do not graze or feed to livestock within 60 days of planting.
metalaxyl	Allegiance FL						✔			**For use in commercial seed-treatment plants only.** See the product labels for rates.
metalaxyl-M + fludioxonil	Apron XL LS + Maxim 480 FS					✔	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product labels for rates.
azoxystrobin + fludioxonil	Dynasty 100FS + Maxim XL					✔	✔	✔	✔	**For use in commercial seed-treatment plants only.** See the product labels for rates.
thiram	Thiram 75 WP						✔	✔	✔	Seed box treatment. Use 55 g/25 kg of seed.
imidacloprid	Gaucho 480 FL		✔		✔					**For use in commercial seed-treatment plants only.** See product label for rates. Request the high rate for flea beetles. Carry-over of Gaucho-treated seed is not recommended.
clothianidin	Poncho 600 FS	✔	✔	✔	✔					**For use in commercial seed-treatment plants only.** See product label for rates. Will also control corn rootworm. One-year plant-back restrictions for leafy, root and tuber vegetables.
thiamethoxam	Cruiser 5FS	✔	✔	✔	✔					**For use in commercial seed-treatment plants only.** See product label for rates. Request the high rate for wireworm.

✔ = registered pest
blank cell = not registered for control of this pest

[1] Also known as 3–5 Leaf Dieback.

Table 3–98. Activity of Fungicides on Sweet Corn Diseases[1]

Common Name	Trade Name	Rust	Northern Corn Leaf Blight	Common Smut	Stewart's Wilt[2]
propiconazole	Tilt 250E	✔	✔		
	Bumper 418 EC	✔	✔		
pyraclostrobin	Headline EC	✔			
azoxystrobin	Quadris Flowable	✔			
chlorothalonil	Bravo 500	✔			
	Echo 720	✔			

✔ = control
blank cell = not registered for control of this pest

[1] For information on seed decay, root rots and 3–5 Leaf Dieback, see Table 3–97, *Sweet Corn Seed Treatments*, previous page.
[2] See Flea Beetles in Table 3–97, *Sweet Corn Seed Treatments*, previous page.

Table 3–99. Sweet Corn Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
RUST, NORTHERN CORN LEAF BLIGHT						
DMI (group 3)	propiconazole	Tilt 250E	500 mL	202 mL	14	Aerial application permitted. Under severe disease pressure, make second application in 14 days.
		Bumper 418 EC	300 mL	121 mL	14	
QoI (group 11)	pyraclostrobin	Headline EC	400–600 mL	162–243 mL	7	**Rust only.** 12-hr re-entry interval.
	azoxystrobin	Quadris Flowable	453 mL	183 mL	7	**Rust only.** Aerial application permitted.
chloronitrile (group M5)	chlorothalonil	Bravo 500	3.2 L	1.3 L	14	**Rust only.** 48-hr re-entry interval.
		Echo 720	2.2 L	0.9 L		

[1] PHI = Pre-harvest Interval (days).

Table 3–100. Activity of Insecticides on Sweet Corn Insects[1]

Common Name	Trade Name	Corn Rootworm	Slugs	Cutworm	Aphids	Fall Armyworm	European Corn Borer	Corn Earworm	Western Bean Cutworm
tefluthrin	Force 3.0 G	✔		✔					
lambda-cyhalothrin	Matador 120EC			✔		✔	✔	(✔)	✔
	Silencer 120 EC			✔		✔	✔	(✔)	*
cypermethrin	Ripcord 400 EC			✔			✔	(✔)	
	UP-Cyde 2.5 EC						✔		
permethrin	Pounce 384EC			✔		✔	✔	(✔)	
	Perm-UP			✔		✔	✔	(✔)	
	Ambush 500EC			✔		✔	✔	(✔)	
deltamethrin	Decis 5 EC					*	✔	(✔)	✔
chlorantraniliprole	Coragen					*	✔	✔	✔
Bacillus thuringiensis	Dipel 2X DF						✔		
	Bioprotec CAF						✔		
carbaryl	Sevin XLR					✔	✔	✔	
methomyl	Lannate TNG						✔	✔	
acephate	Orthene 75 SP						✔		
spinosad	Success 480 SC						✔		
	Entrust 80 W						✔		
chlorpyrifos	Lorsban 4E			✔					
	Pyrinex 480 EC			✔					
	Nufos 4E			✔					
ferric phosphate	Sluggo Professional		✔						
acetamiprid	Assail 70 WP				✔				

✔ = control
(✔) = registered but not considered effective or resistance is documented
* = some control of this pest may be expected when the product is used to control labelled pests
blank cell = not registered for control of this pest

[1] For information on seed corn maggot, wireworm, white grubs and flea beetles, see Table 3–97, *Sweet Corn Seed Treatments*, on page 111.

Table 3-101. Sweet Corn Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CORN ROOTWORM						
pyrethroid (group 3A)	tefluthrin	Force 3.0 G	5 kg	2 kg		Apply in-furrow at planting at a rate of 37.5 g/100 m of row. Will also control seed corn maggot, wireworm and cutworms.
CUTWORMS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	1	Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. 24-hr re-entry interval.
		Silencer 120 EC				
	cypermethrin	Ripcord 400 EC	175 mL	71 mL	21	Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application.
	permethrin	Pounce 384EC	180–390 mL	73–158 mL	–	Apply to moist soils up to 5-leaf stage. Do not disturb soil for 5 days after application. Use high rate on large larvae, dry soils or muck soils.
		Perm-UP				
		Ambush 500 EC	140–300 mL	57–121 mL	–	
organophosphate (group 1B)	chlorpyrifos	Lorsban 4E	1.2–2.4 L	0.5–1 L	70	Apply during 2–5-leaf stage. 24-hr re-entry interval.
		Pyrinex 480 EC				
		Nufos 4E				
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10–20 kg	0	Use high rates on severe infestations.
EUROPEAN CORN BORER, CORN EARWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Time applications to coincide with peak egg hatch. 12-hr re-entry interval.
pyrethroid[2] (group 3A)	lambda-cyhalothrin	Matador 120EC	187 mL	76 mL	1	Apply on a 4–7-day spray interval, depending on local pest pressure. 24-hr re-entry interval.
		Silencer 120 EC				
	deltamethrin	Decis 5 EC	250–300 mL	101–121 mL	5	Aerial or ground applications permitted.
	cypermethrin	Ripcord 400 EC	175 mL	71 mL	5	Aerial or ground applications permitted.
		UP-Cyde 2.5 EC	280 mL	113 mL	5	**European corn borer only.** 12-hr re-entry interval.
	permethrin	Pounce 384EC	275–375 mL	111–152 mL	1	Aerial or ground applications permitted. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	200–275 mL	81–111 mL	1	
biological (group 11)	*Bacillus thuringiensis*	Dipel 2X DF	0.56–1.12 kg	0.22–0.45 kg		**European corn borer only.** Apply when pinhole feeding is observed on 5% of plants. Use high rate on large plants. Apply on a 7-day spray interval.
		Bioprotec CAF	2.8–4.0 L	1.1–1.6 L		
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–4.0 L	1–1.6 L	1	
	methomyl	Lannate TNG	430–625 g	174–253 g	3	Use high rate for corn borer. 24-hr re-entry interval.
	acephate	Orthene 75 SP	563–825 g	228–334 g	21	**European corn borer only.** 5-day re-entry interval (workers must wear gloves in the field for 4 weeks after application).
spinosyn (group 5)	spinosad	Success 480 SC	83 mL	34 mL	7	**European corn borer only.** Use only on very small larvae and low populations. Maintain a spray pH of 6 or greater. 7-day re-entry interval.
		Entrust 80 W	50 g	20 g	7	

[1] PHI = Pre-Harvest Interval (days).

[2] Pyrethroid sprays rapidly degrade at temperatures over 26.5°C, and more frequent spray applications are often required. Spraying during cooler evening temperatures may increase the performance of these products.

Table 3-101. Sweet Corn Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
WESTERN BEAN CUTWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Time applications to coincide with peak egg hatch. 12-hr re-entry interval.
pyrethroid[2] (group 3A)	lambda-cyhalothrin	Matador 120EC	187 mL	76 mL	1	Apply on a 4–7-day spray interval, depending on local pest pressure. 24-hr re-entry interval.
	deltamethrin	Decis 5 EC	250–300 mL	101–121 mL	5	Aerial or ground applications permitted.
FALL ARMYWORM						
pyrethroid[2] (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	1	Aerial or ground applications permitted. 24-hr re-entry interval.
		Silencer 120 EC				
	permethrin	Pounce 384EC	180 mL	73 mL	1	Aerial or ground applications permitted. 12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140 mL	57 mL	1	
APHIDS						
neonicotinoid (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	10	Use high rate for heavy infestations. 12-hr re-entry interval (10 days for hand harvesting).

[1] PHI = Pre-Harvest Interval (days).

[2] Pyrethroid sprays rapidly degrade at temperatures over 26.5°C, and more frequent spray applications are often required. Spraying during cooler evening temperatures may increase the performance of these products.

SWEET POTATOES

Products registered for sweet potato diseases and insects are listed in Table 3–102, *Sweet Potato Insect and Disease Control.*

Table 3-102. Sweet Potato Insect and Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
STEM ROT AND SCURF						
dithiocarbamate (group M3)	thiram	Thiram 75 WP	1.75 kg per 1,000 L water			Dip roots of sprouts for 30 seconds in suspension, then plant promptly.
EUROPEAN CHAFER GRUBS						
neonicotinoid (group 4A)	imidacloprid	Admire 240 F Grapple$_2$ Alias 240 SC	1.2 L	0.5 L	125	Apply in 200 L water/ha as a soil drench after transplant and before foliage covers more than 25% of planting bed. Make only 1 application/season. 24-hr re-entry interval.
FLEA BEETLES						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	33 mL	7	Apply in a minimum of 100 L water/ha. Maximum 3 applications/yr. Allow 7 days between applications. 24-hr re-entry interval. Will also control leafhoppers.
TWO-SPOTTED SPIDER MITES						
tetronic and tetramic acid derivatives (group 23)	spiromesifen	Oberon Flowable	500–600 mL	202–243 mL	7	Apply in adequate water for uniform coverage (at least 100 L/ha for ground applications). No more than 600 mL/ha can be applied per 7-day interval. No more than 2 applications per season. 12-hr re-entry interval. Will also control whiteflies.
APHIDS						
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	7	Most effective on young stages of aphids. Has slow activity; control may not be apparent for up 2–3 weeks. Under high pressure and for faster knockdown, a 2nd application may be necessary 1 week later. Wait at least 7 days between applications. No more than 730 mL/ha product can be applied per season. Will also control psyllids and whiteflies. Must be tank-mixed with spray adjuvant/ additive having spreading and penetrating properties. See label for further details. 12-hr re-entry interval.
flonicamid (group 9C)	Flonicamid	Beleaf 50SG	0.12–0.16 kg	0.05–0.06 kg	7	Thorough spray coverage essential for optimum control. Apply in sufficient water to ensure good coverage. Allow at least 7 days between applications. No more than 3 applications or 0.48 kg/ha per year. 12-hr re-entry interval.

[1] PHI = Pre-Harvest Interval

Table 3-102. Sweet Potato Insect and Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
VARIEGATED CUTWORM, ARMYWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–151 mL	1	Maximum 4 applications per year. Allow at least 3 days between applications. Thorough coverage is important for optimum control. 12-hr re-entry interval.
SLUGS						
inorganic	ferric phosphate	Sluggo Professional	25–50 kg	10.1–20.2 kg		Slugs are not usually a problem in established sweet potato fields but under certain conditions may damage newly planted slips. If damage warrants, scatter bait around base of plants and between rows, to soil that is moist but with little-to-no standing water.
SCLEROTINIA ROT						
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	8–15 L	3.2–6.1 L	0	**Disease suppression only.** Begin applications when conditions are conducive to disease development. Repeat as needed on a 7–10-day interval.
POST-HARVEST DISEASE — BACTERIAL SOFT ROT						
inorganic (group M1)	hydrogen peroxide	StorOx	100 mL per 10 L water			Spray diluted solution on newly harvested roots. Additional applications can be made daily as a direct injection into humidification water. Do not enter treated storage bins until hydrogen peroxide air concentrations are below safe levels.
POST-HARVEST DISEASE — RHIZOPUS ROT						
phenylpyrroles (group 12)	fludioxonil	Scholar 50 WP	473 mL per 378 L water			Mix in water, wax/emulsion or aqueous dilution of wax/oil emulsion. For application as post-harvest dip/drench, dip for approx. 30 sec and allow to drain. After 18,750 kg (750 bu) of sweet potatoes are treated, drain, flush tank and refill with fresh dip suspension. For in-line aqueous or fruit coating spray application, ensure proper coverage of crop. Maximum 1 application.

[1] PHI = Pre-Harvest Interval

TOMATOES

Seed treatments and transplant disease and insect control products registered on tomatoes are listed in Table 3–103, *Tomato Transplant Production Disease and Insect Control.* Activities of products for tomato diseases are listed in Table 3–104, *Activity of Fungicides on Tomato Diseases.* Products registered for tomato diseases are listed in Table 3–105, *Tomato Fungal Disease Control* and Table 3–106, *Tomato Bacterial Disease Control.*

Activities of products for tomato insects are listed in Table 3–107, *Activity of Insecticides on Tomato Insects.* Products registered for tomato insects are listed in Table 3–108, *Tomato Cutworm and Aphid Control,* Table 3–109, *Tomato Colorado Potato Beetle Control* and Table 3–110, *Tomato Insect Control.*

Table 3–103. Tomato Transplant Production Disease and Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	Notes
SEED AND SEEDLING DISEASE					
phenylamide (group 4)	metalaxyl-M and S-isomer	Apron XL-LS		20–40 mL/ 100 kg of seed	Seed treatment. **Pythium damping-off. For import use only** – not for domestic commercial or on-farm treatment.
phenylpyrrole (group 12)	fludioxonil	Maxim 480FS		5.2–10.4 mL/ 100 kg of seed	Seed treatment. Seed decay, damping-off and seedling blight caused by *Fusarium* and *Rhizoctonia*. **For import use only. For application by commercial seed treaters only.**
QoI (group 11)	azoxystrobin	Dynasty 100FS		25–50 mL/ 100 kg of seed	Damping-off (*Rhizoctonia solani*). **For import use only.** Not for domestic commercial or on-farm seed treatment.
dithiocarbamate (group M3)	thiram	Thiram 75 WP		65–80 g/ 25 kg of seed	Seed treatment. Seed decay, seedling blight, damping-off.
phthalimide (group M4)	captan	Maestro 80DF Supra Captan 80 WDG		1.25 kg/ 1,000 L of water Apply 50–85 L of solution per 100 m^2.	Soil drench treatment. **Damping-off, fungus root rot.** 48-hr re-entry interval.
microbial (group 44)	*Trichoderma harzianum*	RootShield Granules		600–750 g per m^3 of loose planting mix or soil	**Suppression.** Root diseases caused by *Pythium, Rhizoctonia, Fusarium.* 4-hr re-entry interval.
		RootShield HC		55–110 g per m^3 of loose planting mix or soil or planting beds	**Suppression.** Root diseases caused by *Pythium, Rhizoctonia, Fusarium.* Potting mix application or drench. 4-hr re-entry interval.
BOTRYTIS GREY MOULD AND POWDERY MILDEW					
hydroxyanilide (group 17)	fenhexamid	Decree 50 WDG	1.5 kg	0.6 kg	**Botrytis grey mould.** 60-day pre-harvest interval. 4-hr re-entry interval.
microbial (group 44)	*Trichoderma harzianum*	RootShield HC		3.75–7.5 g/ 1 L of water	**Botrytis grey mould suppression.** Foliar application. 4-hr re-entry interval. Water volume: spray to wet, but avoid runoff.
	Streptomyces lydicus	Actinovate SP	425–840 g/ 700 L of water	172–340 g/ 280 L of water	**Powdery mildew suppression.** 1-hr re-entry interval. Spray to wet, but avoid runoff.
BACTERIAL DISEASES					
inorganic (group M1)	copper hydroxide	Kocide 2000	3.2 kg	1.3 kg	Apply every 5 days, when warranted, to a maximum of 5 applications over a 4-week period prior to transplanting. Apply in low water volumes. 24-hr re-entry interval.
		Coppercide WP	2.25 kg	0.9 kg	
INSECTS					
biological (group 11)	*Bacillus thuringiensis*	Bioprotec 3P		0.8 kg/ 1,000 L of water	*Duponchelia fovealis.* Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stems is necessary.
Not Classified	*Beauveria bassiana*	BotaniGard 22WP		0.25–1.0 kg/ 400 L of water	Whitefly, aphids, thrips. 4-hr re-entry interval. Spray to wet, but avoid runoff.

Table 3-104. Activity of Fungicides on Tomato Diseases

		Greenhouse (Transplants)					Field							
Common Name	**Trade Name**	**Damping-Off (Seedlings)**	**Root Disease**	**Botrytis Grey Mould**	**Powdery Mildew**	**Bacterial Spot**	**Anthracnose**	**Bacterial Disease [1]**	**Early Blight**	**Botrytis Grey Mould**	**Late Blight**	**Powdery Mildew**	**Septoria Leaf Spot**	**Sclerotinia White Mould**
captan	Maestro 80DF	✔					✔						✔	
	Supra Captan 80 WDG	✔					✔						✔	
Trichoderma harzianum	RootShield Granules		✔											
	RootShield HC		✔	✔						✔				
Streptomyces lydicus	Actinovate SP				+							+		
fenhexamid	Decree 50 WDG			✔										
copper hydroxide	Kocide 2000					✔			✔				✔	
	Coppercide WP					✔		✔						
azoxystrobin	Quadris Flowable						✔		✔					
pyraclostrobin	Cabrio EG						✔		✔		✔		✔	
chlorothalonil	Bravo 500						✔		✔	✔	✔		✔	
	Echo 90DF						✔		✔	✔	✔		✔	
mancozeb	Dithane DG						✔		✔		✔			
	Manzate Pro-Stick						✔		✔		✔			
	Penncozeb 80WP						✔		✔		✔			
metiram	Polyram DF						✔		✔		✔		✔	
boscalid	Lance WDG/ Cantus WDG								✔	✔				
famoxadone/ cymoxanil	Tanos 50 DF								✔		✔			
mandipropamid	Revus										✔			
fluopicolide	Presidio										✔			
difenoconazole	Inspire						✔		✔					
pyrimethanil	Scala SC								✔	✔				
copper hydroxide	Parasol Flowable							✔	✔		✔		✔	
copper sulfate	Copper 53W						✔		✔		✔		✔	
folpet	Folpan						✔							
Bacillus subtilis	Serenade ASO							+	+	+		+		
Coniothyrium minitans	Contans													✔
potassium bicarbonate	MilStop											✔		

✔ = control
\+ = suppression
blank cell = not registered for control of this pest

[1] See label for details.

Table 3-105. Tomato Fungal Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
ANTHRACNOSE, EARLY BLIGHT, LATE BLIGHT, SEPTORIA LEAF SPOT						
QoI (group 11)	azoxystrobin	Quadris Flowable	300–500 mL	121–202 mL	1	**Early blight, anthracnose only.** Do not apply for 21 days after transplanting. Do not apply for 6 days before or after using metribuzin.
	pyraclostrobin	Cabrio EG	560–840 g	227–340 g	0	Use up to 1 kg/ha (400 g/acre) for late blight. Do not make more than 2 applications before rotating to a different fungicide group (one for late blight). 12-hr re-entry interval.
chloronitrile (group M5)	chlorothalonil	Bravo 500	2.4–4.0 L	1–1.6 L	1	48-hr re-entry interval.
		Echo 90DF	1.3–2.2 kg	0.5–0.9 kg		
dithiocarbamate (group M3)	mancozeb	Dithane DG Rainshield	1.1–3.25 kg	0.45–1.3 kg	7	**Early blight, anthracnose, late blight only.** 24-hr re-entry interval.
		Manzate Pro-Stick	1.75–3.25 kg	0.7–1.3 kg		
		Penncozeb 80WP	1.1–3.25 kg	0.45–1.3 kg		
	metiram	Polyram DF	2.25–3.25 kg	0.9–1.3 kg	7	Low rate for early and late blight; high rate for anthracnose and septoria leaf spot.
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	175–315 g	71–127 g	0	**Early blight only.** Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
QoI/ cyanoacetamide oxime (group 11/27)	famoxadone/ cymoxanil	Tanos 50 DF	560–840 g	227–340 g	3	**Early blight and late blight only.** Alternate with fungicides having a different mode of action than group 11 or 27. 24-hr re-entry interval.
carboxylic acid amides (group 40)	mandipropamid	Revus	400–600 mL	162–243 mL	1	**Late blight only.** The use of a non-ionic adjuvant (0.25% v/v) is recommended. A tank mix with Bravo 500 is recommended. 12-hr re-entry interval.
benzamide + chloronitrile (group 43+M5)	fluopicolide + chlorothalonil	Presidio Fungicide + Bravo 500	220–292 mL + 2.4–4.0 L	89–118 mL + 1–1.6 L	2	Do not make sequential applications. 48-hr re-entry interval. See product label for rotational restrictions.
DMI (group 3)	difenoconazole	Inspire	292–512 mL	118–207 mL	0	**Anthracnose and early blight.** Use high rate for anthracnose control. Do not use on varieties in which the mature tomatoes will be less than 5 cm (such as cherry tomatoes). Apply no more than 2 sequential applications. 12-hr re-entry interval.
anilino-pyrimidines + chloronitrile (group 9+M5)	pyrimethanil + chlorothalonil	Scala SC + Bravo 500	750 mL + 2.4–4.0 L	304 mL + 1–1.6 L	1	48-hr re-entry interval.
inorganic (group M1)	copper hydroxide	Kocide 2000	2.24–2.52 kg	0.9–1 kg	1	**Early blight and septoria leaf spot only.** 24-hr re-entry interval.
inorganic + dithiocarbamate (group M1+M3)	copper hydroxide + mancozeb	Parasol Flowable + Dithane DG Rainshield	2.3 L + 1.87–2.4 kg	0.9 L + 0.76–1.0 kg	7	48-hr re-entry interval.

[1] PHI = Pre-Harvest Interval (days).

Table 3-105. Tomato Fungal Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
phthalimide (group M4)	captan	Maestro 80DF	2.75–4.25 kg	1.1–1.7 kg	2	**Anthracnose and septoria leaf spot only.** Use high rate on mature plants or for severe infections. 48-hr re-entry interval.
		Supra Captan 80 WDG				
	folpet	Folpan	5 kg	2 kg	1	**Anthracnose only.** 24-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	8–15 kg	3.2–6.1 kg	0	**Early blight suppression only.** Also suppresses powdery mildew. Make first application when conditions are conducive for disease development.
BOTRYTIS GREY MOULD AND SCLEROTINIA WHITE MOULD						
chloronitrile (group M5)	chlorothalonil	Bravo 500	4.8 L	1.9 L	1	**Botrytis grey mould.** 48-hr re-entry interval.
		Echo 90DF	2.7 kg	1.1 kg		
SDHI (group 7)	boscalid	Lance WDG/ Cantus WDG	420 g	170 g	0	**Botrytis grey mould.** Do not make more than 2 applications before rotating to a different fungicide group. 12-hr re-entry interval.
anilino-pyrimidines + chloronitrile (group 9+M5)	pyrimethanil + chlorothalonil	Scala SC + Bravo 500	750 mL + 2.4–4.0 L	304 mL + 1–1.6 L	1	**Botrytis grey mould.** 48-hr re-entry interval.
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	4–15 kg	1.6–6.1 kg	0	**Botrytis grey mould. Suppression only.** Make first application when conditions are conducive for disease development.
	Trichoderma harzianum	RootShield HC	3.75–7.5 g/L of water		0	**Botrytis grey mould. Suppression only.** Foliar application. 4-hr re-entry interval. Water volume: spray to wet, but avoid runoff.
	Coniothyrium minitans	Contans WG	2–4 kg	0.8–1.6 kg	0	**Sclerotinia white mould. Suppression only.** Apply to soil prior to or at planting or at time of transplant at least 3 months prior to typical onset of disease. Regular use of Contans WG in successive years within a long-term management strategy will improve disease control. If incorporation will displace soil greater than 5 cm, increase application rate to 3–6 kg/ha (1.2–2.4 kg/acre).

[1] PHI = Pre-Harvest Interval (days).

Table 3-106. Tomato Bacterial Disease Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
inorganic + dithiocarbamate (group M1+M3)	copper hydroxide + mancozeb	Kocide 2000 + Manzate Pro-Stick	3.2 kg + 1.87–2.4 kg	1.3 kg + 0.76–1 kg	7	Apply 7 days after transplanting and repeat at 7-day intervals for at least 3 applications. Apply more frequently under wet conditions. If wet conditions persist, continue applications until early bloom. 24-hr re-entry interval (Kocide); 48-hour re-entry interval (Parasol).
		Parasol WG + Dithane DG Rainshield	2.25 kg + 1.87–2.4 kg	0.9 kg + 0.76–1 kg	7	
		Coppercide WP + Manzate Pro-Stick	2.25 kg + 1.87–2.4 kg	0.9 kg + 0.76–1 kg	7	
microbial (group 44)	*Bacillus subtilis*	Serenade ASO	4–15 kg	1.6–6 kg	0	**Suppression only.** Begin applications soon after transplant. Repeat as necessary on a 7–10-day interval. When conditions are conducive to rapid disease development, use in a rotational program with other bactericides.

[1] PHI = Pre-Harvest Interval (days).

Table 3-107. Activity of Insecticides on Tomato Insects

Common Name	Trade Name	Greenhouse (Transplant)			Field											
		Duponchelia foveallis	Whitefly, Aphids, Thrips	Cabbage Looper, Hornworms	Aphids	Cabbage Looper	Colorado Potato Beetle	Cutworms (Early-Season or Climbing)	Drosophila	Hornworm	Mites	Stink Bug	Tarnished Plant Bug	Tomato Fruitworm	Wireworm	Flea Beetle
Bacillus thuringiensis	Bioprotec 3P	✔														
	Bioprotec CAF			✔		✔				✔				✔		
Beauveria bassiana	BotaniGard 22WP		✔													
lambda-cyhalothrin	Matador 120EC						✔	✔								
	Silencer 120 EC						✔	✔					✔			
permethrin	Pounce 384EC						✔	✔					✔			
	Perm-UP						✔	✔		✔				✔		
	Ambush 500EC						✔	✔		✔				✔		
chlorantraniliprole	Coragen						✔	✔		✔				✔		
carbaryl	Sevin XLR					✔	✔	✔		✔				✔		
methomyl	Lannate TNG						(✔)	✔		✔		✔	✔	✔		✔
acephate	Orthene 75 SP				✔			✔						✔		
acetamiprid	Assail 70 WP				✔		✔	✔							✔	✔
thiamethoxam	Actara 240 SC				✔		✔									
spirotetramat	Movento 240 SC				✔											
flonicamid	Beleaf 50SG				✔											
endosulfan	Thiodan 4 EC				✔											
diazinon	Diazinon 50 W				✔		✔			✔				✔		✔
dimethoate	Cygon 480				✔				✔							
	Lagon 480				✔											
malathion	Malathion 25W				✔								✔			
imidacloprid	Admire 240 F						(✔)				(✔)					
	Alias 240 SC						✔									
	Grapple						✔									
Bacillus thuringiensis	Novodor						✔									
imidacloprid/ deltamethrin	Concept						✔			✔						
deltamethrin	Decis 5 EC						✔									
cypermethrin	Ripcord 400 EC						✔									✔
	UP-Cyde 2.5 EC						✔									✔
spinosad	Success 480 SC					✔	✔									
	Entrust 80 W					✔	✔									
Bacillus thuringiensis	Thuricide HPC					✔				✔						
	Dipel 2X DF					✔				✔				✔		
spinetoram	Delegate WG					✔										
naled	Dibrom								✔	✔				✔		
spiromesifen	Oberon Flowable										✔					

✔ = control

(✔) = registered but not considered effective or resistance is documented

blank cell = not registered for control of this pest

Table 3–108. Tomato Cutworm and Aphid Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
CUTWORMS						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	7	Apply in the late evening or at night. Do not disturb the soil for 5 days after application. 24-hr re-entry interval.
		Silencer 120 EC				
	permethrin	Pounce 384EC	180–260 mL	73–105 mL	0	12-hr re-entry interval.
		Perm-UP				
		Ambush 500EC	140–200 mL	57–81 mL	1	
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
carbamate (group 1A)	carbaryl	Sevin XLR	45 mL/ 100 m of row	14 mL/ 100 ft of row	2	
	methomyl	Lannate TNG	270–540 g	109–219 g	1	
organophosphate (group 1B)	acephate	Orthene 75 SP	0.9 kg in 2,000 L water	0.35 kg in 178 gal (imp.) water		Also controls wireworm. Based on 14,000 plants/ha. Transplanting water treatment only. **Caution:** Temporary plant damage may occur on sandy soils. 12-hr re-entry interval.
APHIDS						
neonicotinoid[2] (group 4A)	acetamiprid	Assail 70 WP	56–86 g	23–35 g	7	Do not apply a foliar neonicotinoid in the same season as a soil application. Alternate applications with other insecticide groups. 12-hr re-entry interval.
	thiamethoxam	Actara 25WG	105 g	42 g	1	Do not apply a foliar neonicotinoid in the same season as a soil application. Alternate applications with other insecticide groups. 12-hr re-entry interval.
tetronic and tetramic acid derivatives (group 23)	spirotetramat	Movento 240 SC	220–365 mL	89–148 mL	1	Most effective on young stages. Has slow activity; control may not be apparent for 2–3 weeks. Must be tank-mixed with an adjuvant. See label for details. 12-hr re-entry interval.
flonicamid (group 9C)	flonicamid	Beleaf 50 SG	120–160 g	49–65 g	0	12-hr re-entry interval.
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[3]	1.5–2.75 L	0.6–1.1 L	27	4-day re-entry interval.
		Thionex EC	1.5–2.5 L	0.6–1 L	27	4-day re-entry interval.
organophosphate (group 1B)	diazinon[4]	Diazinon 50 W	1.1–1.75 kg	0.45–0.7 kg	1	Less effective below 20°C.
	dimethoate	Cygon 480	0.55–1.1 L	0.22–0.45 L	7	
		Lagon 480				
	malathion[4]	Malathion 25 W	2.75–4.25 kg	1.1–1.7 kg	3	Less effective below 20°C. Control of aphids with malathion has been inconsistent in many areas.
	acephate	Orthene 75 SP	0.9 kg in 2,000 L water	0.35 kg in 178 gal water		Based on 14,000 plants/ha. **Transplanting water treatment only.** Temporary plant damage may occur on sandy soils. 12-hr re-entry interval.
carbamate (group 1A)	methomyl	Lannate TNG	270–540 g	109–219 g	1	

[1] Pre-Harvest Interval (days).
[2] Do not apply a foliar neonicotinoid in the same season as a soil application.
[3] Registration expires on December 31, 2013.
[4] Control of aphids with diazinon and malathion has been inconsistent in many areas.

Table 3-109. Tomato Colorado Potato Beetle Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
Transplant Treatment						
neonicotinoid[2] (group 4A)	imidacloprid	Admire 240 F Alias 240 SC Grapple$_2$	7–10 mL/ 100 m of row	2–3 mL/ 100 ft of row		Apply in-furrow at transplanting. Consult the label for application details. Do not apply a foliar neonicotinoid in the same season as a soil application. 24-hr re-entry interval.
organophosphate (group 1B)	acephate	Orthene 75 SP	0.9 kg in 2,000 L of transplant water	0.35 kg in 178 gal of transplant water		Based on 14,000 plants/ha. Transplanting water treatment only. **Caution:** Temporary plant damage may occur on sandy soils. 12-hr re-entry interval.
Foliar Treatment						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
biological (group 11)	*Bacillus thuringiensis*	Novodor	4–8 L	1.6–3.2 L	0	Effective on small larvae. Field scouting is essential for timing of sprays.
neonicotinoid[2] (group 4A)	imidacloprid	Admire 240 F Alias 240 SC Grapple$_2$	200 mL	81 mL	7	Do not apply a foliar neonicotinoid in the same season as a soil application. Alternate applications with other insecticide groups. 24-hr re-entry interval.
	acetamiprid	Assail 70 WP	40–80 g	16–32 g	7	Alternate applications with other insecticide groups. 12-hr re-entry interval.
neonicotinoid[2]/ pyrethroid (group 4A/3A)	imidacloprid/ deltamethrin	Concept	650 mL	263 mL	7	Alternate applications with other insecticide groups. 24-hr re-entry interval.
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC Silencer 120 EC	83–125 mL	34–51 mL	7	Use the higher rate for larger instars or higher populations of larvae. 24-hr re-entry interval.
	deltamethrin	Decis 5 EC	100–150 mL	40–61 mL	3	Do not apply after August 1.
	cypermethrin	Ripcord 400 EC	85 mL	34 mL	3	
		UP-Cyde	140 mL	57 mL	3	12-hr re-entry interval.
	permethrin	Pounce 384EC Perm-UP	180–260 mL	73–105 mL	0	12-hr re-entry interval.
		Ambush 500EC	140–200 mL	57–81 mL	1	
spinosyn (group 5)	spinosad	Success 480 SC	83 mL	34 mL	1	Use only on small larvae and low infestations. Maintain a spray water pH of 6 or greater.
		Entrust 80 W	50 g	20 g	1	

[1] Pre-Harvest Interval (days).
[2] Do not apply a foliar neonicotinoid in the same season as a soil application.

Table 3-110. Tomato Insect Control

Group Name (Group #)	Common Name	Trade Name	Rate per Hectare	Rate per Acre	PHI[1]	Notes
TARNISHED PLANT BUG						
pyrethroid (group 3A)	lambda-cyhalothrin	Matador 120EC	83 mL	34 mL	7	24-hr re-entry interval.
		Silencer 120 EC				
organophosphate (group 1B)	dimethoate	Lagon 480	0.55–1.1 L	0.22–0.45 L	7	
carbamate (group 1A)	carbaryl	Sevin XLR	5.25–6.4 L	2.1–2.6 L	2	Also controls stink bugs.
HORNWORM						
diamide (group 28)	chlorantraniliprole	Coragen	250–375 mL	101–152 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
neonicotinoid[2]/ pyrethroid (group 4A/3A)	imidacloprid/ deltamethrin	Concept	650 mL	263 mL	7	Alternate applications with other insecticide groups. 24-hr re-entry interval.
biological (group 11)	*Bacillus thuringiensis*	Thuricide HPC	0.75–1.5 L	0.3–0.6 L	0	Apply at first signs of infestation when larvae are small.
		Dipel 2X DF	140–275 g	57–111 g	0	
		Bioprotec CAF	0.65–1.1 L	0.25–0.45 L	0	
pyrethroid (group 3A)	permethrin	Pounce 384 EC	180–260 mL	73–105 mL	0	12-hr re-entry interval.
		Perm-UP				
		Ambush 500 EC	140–200 mL	57–81 mL	1	
carbamate (group 1A)	carbaryl	Sevin XLR	2.5–5.25 L	1.0–2.1 L	2	
cyclodiene organochlorines (group 2A)	endosulfan	Thiodan 4EC[3]	1.5–2.75 L	0.6–1.11 L	27	4-day re-entry interval.
		Thionex EC	1.5–2.5 L	0.6–1 L	27	4-day re-entry interval.
CABBAGE LOOPER						
diamide (group 28)	chlorantraniliprole	Coragen	250 mL	101 mL	1	Early application on larval stages provides best control. 12-hr re-entry interval.
biological (group 11)	*Bacillus thuringiensis*	Thuricide HPC	2.0–4.25 L	0.8–1.7 L	0	Apply at first signs of infestation when larvae are small.
		Dipel 2X DF	275–550 g	111–223 g	0	
		Bioprotec CAF	1.4–2.8 L	0.6–1.1 L	0	
spinosyn (group 5)	spinetoram	Delegate WG	140–200 g	57–81 g	1	12-hr re-entry interval.
DROSOPHILA (FRUIT FLY)						
organophosphate (group 1B)	diazinon	Diazinon 50 W	1.1–1.75 kg	0.45–0.7 kg	1	
	naled	Dibrom	1.1 L	0.45 L	4	48-hr re-entry interval.
TWO-SPOTTED SPIDER MITE						
tetronic and tetramic acid derivatives (group 23)	spiromesifen	Oberon Flowable	500–600 mL	202–243 mL	7	Apply before mite populations begin to build up. Control may not be apparent for 2–3 weeks, especially under cool temperatures. 12-hr re-entry interval.

[1] Pre-Harvest Interval (days).
[2] Do not apply a foliar neonicotinoid in the same season as a soil application.
[3] Registration expires on December 31, 2013.

4. Pesticides Used on Vegetable Crops in Ontario

For information on pesticides used on vegetable crops in Ontario, see Table 4–1, *Pesticides Used on Vegetable Crops in Ontario*, this page, Table 4–3, *Re-Entry Intervals for Pesticides Used on Vegetable Crops*, on page 140, Table 1–1, *Biopesticides Used on Vegetable Crops in Ontario*, on page 6, Table 1–2, *Insecticide Groups Based on Sites of Action*, on page 8, and Table 1–3, *Fungicide Groups Based on Mode of Action*, on page 9.

Table 4–1. Pesticides Used on Vegetable Crops in Ontario

Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
abamectin	*See AGRI-MEK*					
acephate	*See ORTHENE*					
acetamiprid	*See ASSAIL*					
ACROBAT 50 WP	dimethomorph	f	50	3	potatoes	ENG
ACTARA 240SC	thiamethoxam	i	240 g/L	3	potatoes	SYZ
ACTARA 25WG	thiamethoxam	i	25	3	celery, leafy greens (see label), eggplant, lettuce, endive, parsley, peppers, rhubarb, spinach, Swiss chard, potatoes, tomatoes	SYZ
ACTINOVATE SP	*Streptomyces lydicus*	f	1.0 x 10^7 CFU/g	4	peppers, tomatoes	PLG
ADMIRE 240 F	imidacloprid	i	240 g/L	4	brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, potatoes, sweet potatoes, tomatoes	BCZ
ADMIRE 240 SPT	imidacloprid	i	240 g/L	4	potato seed piece	BCZ
AGRI-MEK 1.9% EC	abamectin	i	19 g/L	3	celery, potatoes	SYZ
AGROX B-2	diazinon/ captan	s	11/ 33.5	3	beans, peas, sweet corn	NRA
AGROX CD	diazinon/ captan	s	15/ 15	3	beans, peas, sweet corn	NRA
ALIAS 240 SC	imidacloprid	i	240 g/L	4	eggplant, lettuce, potatoes, sweet potatoes, tomatoes	UAG/ MAN
ALIETTE WDG	fosetyl-al	f	80	3	broccoli, bok choy, lettuce, onions, rutabagas	BCZ
ALLEGIANCE FL	metalaxyl	s	317 g/L	3	beans, peas, sugarbeets, sweet corn	BCZ
ALLEGRO 500F	fluazinam	f	500 g/L	3	beans, brassica crops, carrots, potatoes	ISK

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Table 4–1. Pesticides Used on Vegetable Crops in Ontario

Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
AMBUSH 500EC	permethrin	i	500 g/L	4	asparagus, beans, beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, carrots, horseradish, lettuce, onions, peas, peppers, potatoes, radishes, sugarbeets, sweet corn, tomatoes	ENG
APRON MAXX RFC	metalaxyl-M/ fludioxonil	s	3.46/ 2.31	3	beans, peas	SYZ
APRON XL LS	metalaxyl-M	s	33.3	3	beans, beets (table), brassica crops, carrots, cucurbits (vine crops), eggplant, leafy greens, lettuce, onions, parsnips, peas, peppers, radishes, rutabagas, spinach, sugarbeets, sweet corn, tomatoes	SYZ
ASSAIL 70 WP	acetamiprid	i	70	4	brassica crops, celery, lettuce, endive, parsley, spinach, Swiss chard, leafy greens (see label), peppers, potatoes, rhubarb, sweet corn, tomatoes	DUQ
azoxystrobin	*See QUADRIS, DYNASTY*					
Bacillus subtilis	*See SERENADE*					
Bacillus thuringiensis	*See NOVODOR, DIPEL, THURICIDE, BIOPROTEC*					
Beauveria bassiana	*See BOTANIGARD*					
BELEAF 50SG	flonicamid	i	50	4	beets (table), brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, endive, parsley, parsnips, peppers, potatoes, radishes, rhubarb, rutabagas, spinach, Swiss chard, sweet potatoes, tomatoes	ISK/ UAG
BIOPROTEC 3P	*Bacillus thuringiensis*	i	25,000 IU/mg	4	peppers, tomatoes (transplants)	
BIOPROTEC CAF	*Bacillus thuringiensis*	i	11,400 IU/mg	3	beans (snap), brassica crops, celery, herbs, lettuce, parsley, spinach, sweet corn, tomatoes, transplants (tomato and pepper)	AFG
BOTANIGARD 22WP	*Beauveria bassiana*	i	4.4 x 10^{13} conidia/kg	3	eggplant, peppers, tomatoes	BWI
BOTRAN 75W	dicloran	f	75	4	beans, garlic, lettuce	GOW
boscalid	*See LANCE, CANTUS*					
BRAVO 500	chlorothalonil	f	500 g/L	4	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, cucurbits (vine crops), onions, parsnips, potatoes, sweet corn, tomatoes	SYZ
BUMPER 418 EC	propiconazole	f	418 g/L	3	sweet corn	UAG/ MAN

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CABRIO EG	pyraclostrobin	f	20	4	beets (table), carrots, cucurbits (vine crops), eggplant, garlic, horseradish, onions, peppers, radish, rutabaga, tomatoes	BAZ
CANTUS WDG	boscalid	f	70	2	carrots, cucurbits (vine crops), eggplant, lettuce, onions, peppers, potatoes, tomatoes	ENG
captan	*See MAESTRO, SUPRA CAPTAN*					
carbaryl	*See SEVIN XLR*					
carbathiin/thiram	*See PRO-GRO, VITAFLO*					
chlorantraniliprole	*See CORAGEN*					
chlorothalonil	*See BRAVO, ECHO*					
chlorpyrifos	*See LORSBAN, PYRIFOS, PYRINEX, NUFOS*					
CITATION 75WP	cyromazine	i	75	3	brassica leafy greens (see label), celery, lettuce, leafy greens (see label), parsley, spinach, Swiss chard	SYZ
clothianadin	*See PONCHO, TITAN, CLUTCH*					
CLUTCH	clothianidin	i	50	2	potatoes	ENG
CONCEPT	imidacloprid/ deltamethrin	i	75 g/L/ 10 g/L	3	brassica crops, tomatoes	BCZ
Coniothyrium minitans	*See CONTANS*					
CONTANS WG	*Coniothyrium minitans*	f	5.3	4	beans, cabbage, carrots, celery, lettuce, tomatoes	PLG
COPPER 53W	copper sulfate	f	53.4	3	beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), potatoes	UAG
copper hydroxide	*See COPPERCIDE,KOCIDE, PARASOL*					
copper oxychloride	*See COPPER SPRAY*					
COPPER SPRAY	copper oxychloride	f	50	4	celery, cucurbits (vine crops), potatoes	UAG
copper sulfate	*See COPPER 53W*					
COPPERCIDE WP	copper hydroxide	f	50	3	beans, cucumbers, peppers, potatoes, tomatoes (field and transplants)	UAG
CORAGEN	chlorantraniliprole	i	200 g/L	2	beans, brassica crops, leafy vegetables (see label), cucurbits (vine crops), eggplant, lettuce, peas, peppers, potatoes, rhubarb, spinach, Swiss chard, sweet corn, sweet potatoes, tomatoes	DUQ
COUNTER 15 G	terbufos	i	15	2	sugarbeets	AMV
CRUISER 5FS	thiamethoxam	s	47.6	3	beans, peas, sugarbeets, sweet corn	SYZ
CRUISER POTATO	thiamethoxam	s	240 g/L	3	potatoes	SYZ

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Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
CURZATE 60 DF	cymoxanil	f	60	3	potatoes	DUQ
cyazofamid	*See RANMAN*					
CYGON 480	dimethoate	i	480 g/L	3	asparagus, beans, beets (table), bok choy, broccoli, Brussels sprouts, cauliflower, Chinese broccoli, eggplant, kale, lettuce (leaf), peas, peppers, potatoes, Swiss chard, tomatoes	BAT, CAU
cymoxanil	*See CURZATE*					
cypermethrin	*See RIPCORD, UP-CYDE*					
cyprodinil/fludioxonil	*See SWITCH*					
cyromazine	*See GOVERNOR, CITATION*					
DADS	diallyl disulfide	f	90	3	garlic, onions, leeks, chives, shallots	UAP
DCT	diazinon/ captan/ thiophanate-methyl	s	6/ 18/ 14	4	sweet corn	NRA
DECIS 5 EC	deltamethrin	i	50 g/L	3	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, kale, onions, peppers, potatoes, sweet corn, tomatoes	BCZ
DECREE 50 WDG	fenhexamid	f	50	3	tomato transplants (greenhouse)	ALS
DELEGATE WG	spinetoram	i	25	3	asparagus, brassica crops, leafy vegetables, potatoes, radish, rhubarb, rutabagas, spinach, Swiss chard, tomatoes	DWE
deltamethrin	*See DECIS*					
diallyl disulfide	*See DADS*					
diazinon	*See DIAZINON*					
diazinon/captan	*See AGROX*					
diazinon/captan/ thiophanate-methyl	*See DCT*					
DIAZINON 50 W	diazinon	i	50	3	carrots, onions, parsnips, peppers, radishes, spinach, Swiss chard, tomatoes	UAG
DIAZINON 500 E	diazinon	i	500 g/L	3	lettuce, onions, parsnips	UAG
DIBROM	naled	i	864 g/L	3	beans (lima), broccoli, Brussels sprouts, cabbage, cauliflower, celery, lettuce, onions, peas, potatoes, spinach, sugarbeets, tomatoes	UAG
dicloran	*See BOTRAN*					
difenoconazole	*See INSPIRE*					
difenoconazole/ metalaxyl-M	*See DIVIDEND*					
dimethoate	*See CYGON, LAGON*					

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dimethomorph	*See ACROBAT*					
DIPEL 2X DF	*Bacillus thuringiensis*	i	57 32,000 CLU/mg	4	brassica crops, herbs, lettuce, parsley, Asian radish, spinach, sweet corn, tomatoes	VBC
DITHANE DG RAINSHIELD	mancozeb	f	75	4	carrots, celery, cucurbits (vine crops), dry onions, potatoes, tomatoes	DWE
DITHANE F-45	mancozeb	f	37	4	seed potatoes (post harvest)	DWE
DIVIDEND XL RTA	difenoconazole/ metalaxyl-M	s	3.37/ 0.27	3	sweet corn	SYZ
DYNASTY 100FS	azoxystrobin	s	100 g/L	3	brassica crops, carrots, cucurbits, eggplant, leafy vegetables, lettuce, onions, parsnips, peppers, radishes, rutabaga, spinach, Swiss chard, sweet corn, tomatoes	SYZ
ECHO 720	chlorothalonil	f	720 g/L	4	cucurbits (vine crops), onions, parsnips, sweet corn	UAG
ECHO 90DF	chlorothalonil	f	90	4	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, tomatoes	UAG
endosulfan	*See THIODAN, THIONEX*					
ENTRUST 80 W	spinosad	i	80	3	asparagus, beans, brassica crops, celery, eggplant, lettuce, endive, leafy greens, parsley, green onions, leeks, chives, peppers, potatoes, radishes, rhubarb, rutabagas, turnips, spinach, Swiss chard, sweet corn, tomatoes	DWE
FALGRO	gibberellic acid	pgr	1 g/tablet	4	potatoes	NRA
famoxadone/cymoxanil	*See TANOS*					
fenamidone	*See REASON*					
fenhexamid	*See DECREE*					
ferbam	*See FERBAM*					
FERBAM 76 WDG	ferbam	f	76	4	transplant lettuce	UAG
ferric phosphate	*See SLUGGO*					
flonicamid	*See BELEAF*					
fluazinam	*See ALLEGRO*					
fludioxonil	*See MAXIM, SCHOLAR*					
fludioxonil/ mancozeb	*See MAXIM MZ*					
fludioxonil/metalaxyl-M	*See MAXIM XL*					
fluopicolide	*See PRESIDIO*					
folpet	*See FOLPAN*					
FOLPAN 80 WDG	folpet	f	80	4	cucurbits (vine crops), tomatoes	UAG

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FORCE 3.0G	tefluthrin	i	3	3	sweet corn	SYZ
fosetyl-al	*See ALIETTE*					
FULFILL 50 WG	pymetrozine	i	50	3	potatoes	SYZ
GAUCHO 480 FL	imidacloprid	s	480 g/L	4	beans, sweet corn	BCZ
GAVEL 75 DF	zoxamide/ mancozeb	f	8.3/ 66.7	4	potatoes	GOW
gibberillic acid	*See FALGRO*					
Gliocladium catenulatum	*See PRESTOP*					
GOVERNOR 75WP	cyromazine	s	75	2	imported onion seed	SYZ
GRAPPLE$_2$	imidacloprid	i	240 g/L	3	cucurbits (vine crops), eggplant, lettuce, potatoes, sweet potatoes, tomatoes	CAU
HEADLINE EC	pyraclostrobin	f	250 g/L	3	beans, peas, potatoes, sugarbeets, sweet corn	BAZ
hydrogen peroxide	*See STOROX*					
imidacloprid	*See ADMIRE, GAUCHO, ALIAS, GRAPPLE$_2$*					
imidacloprid/ deltamethrin	*See CONCEPT*					
IMIDAN 50-WP	phosmet	i	50	4	carrots, celery	GOW
INSPIRE	difenoconazole	f	250 g/L	3	brassica crops, cucurbits (vine crops), eggplant, garlic, leek, onion, shallot, peppers, potatoes, sugarbeets, tomatoes	SYZ
iprodione	*See ROVRAL*					
kaolin clay	*See SURROUND*					
KOCIDE 2000	copper hydroxide	f, s	53.8	3	beans, peppers (field and transplants), potatoes, tomatoes (field and transplants)	DUQ
LAGON 480	dimethoate	i	480 g/L	3	asparagus, beans, beets (table), bok choy, broccoli, Brussels sprouts, cauliflower, Chinese broccoli, eggplant, lettuce (leaf), peas, peppers, potatoes, Swiss chard, tomatoes	UAG
lambda-cyhalothrin	*See MATADOR, SILENCER*					
LANCE WDG	boscalid	f	70	2	beans (snap and lima), carrots, cucurbits (vine crops), eggplant, lettuce, onions, peas, peppers, potatoes, tomatoes	BAZ
LANNATE TNG	methomyl	i	90	2	beans, broccoli, Brussels sprouts, cabbage, cauliflower, lettuce, peas, sweet corn, tomatoes	DUQ
LORSBAN 15G	chlorpyrifos	i	15	4	broccoli, Brussels sprouts, cabbage, cauliflower, onions, rutabaga	DWE

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LORSBAN 4E	chlorpyrifos	i	480 g/L	3	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, cucumber, garlic, onions (dry), pak choy, peppers, potatoes, radishes, rutabagas, sugarbeets, sweet corn	DWE
LORSBAN 50W	chlorpyrifos	i	50	3	cabbage	DWE
MAESTRO 80DF	captan	f	80	3	cucumber, tomatoes, vegetable transplants in greenhouse (crucifer, eggplant, pepper, tomatoes, celery)	ALS
malathion	*See MALATHION*					
MALATHION 25W	malathion	i	25	4	asparagus, beets (table), cucurbits (vine crops), eggplant, peas, peppers, spinach, tomatoes	UAG
MALATHION 85E	malathion	i	85	3	beans, celery, garlic, lettuce, peas, radishes, sugarbeets	UAG
mancozeb	*See DITHANE, TUBERSEAL, PENNCOZEB, MANZATE PRO-STICK, SOLAN*					
mandipropamid	*See REVUS*					
MANZATE PRO-STICK	mancozeb	f	75	3	carrots, celery, cucurbits (vine crops), onions (dry), potatoes, sugarbeets, tomatoes	DUQ
MATADOR 120EC	lambda-cyhalothrin	i	120 g/L	2	asparagus, beans, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, garlic, leeks, lettuce, onions, peas, potatoes, sweet corn, sweet potatoes, tomatoes	SYZ
MAXIM 480FS	fludioxonil	s	40.3	3	beets (table), brassica crops, cucurbits, eggplant, herbs, peppers, sugarbeets, sweet corn, tomatoes	SYZ
MAXIM MZ PSP	fludioxonil/ mancozeb	s	0.5/ 5.7	3	potato seed piece	SYZ
MAXIM PSP	fludioxonil	s	0.5	3	potato seed piece	SYZ
MAXIM LIQUID PSP	fludioxonil	f	40.3	3	potato seed piece	SYZ
MAXIM XL	fludioxonil/ metalaxyl-M	s	21/ 8.4	3	sweet corn	SYZ
metalaxyl	*See RIDOMIL, APRON, ALLEGIANCE*					
metalaxyl-M	*See RIDOMIL GOLD, APRON XL LS*					
metalaxyl-M+ chlorothalonil	*See RIDOMIL GOLD + BRAVO*					
metalaxyl-M/ mancozeb	*See RIDOMIL GOLD MZ*					
metalaxyl-M/ fludioxonil	*See APRON MAXX*					

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methamidophos	*See MONITOR*					
methomyl	*See LANNATE TNG*					
metiram	*See POLYRAM*					
MICROSCOPIC SULPHUR	sulphur	f	92	4	rutabagas	UAG
MICROTHIOL DISPERSS	sulfur	f	80	4	peas	UAG
MILSTOP	potassium bicarbonate	f	85	1	cucurbits (vine crops), peppers	BWI
mineral oil	*See SUPERIOR 70 OIL*					
MISSION 418 EC	propiconazole	f	418 g/L	3	asparagus, rutabagas	UAP/ MAN
MONITOR 480	methamidophos	i	480 g/L	2	broccoli, Brussels sprouts, cabbage, cauliflower, head lettuce, potatoes	BCZ
MOVENTO 240 SC	spirotetramat	i	240 g/L	4	brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, endive, parsley, peppers, potatoes, rhubarb, spinach, Swiss chard, sweet potatoes, tomatoes	BCZ
myclobutanil	*See NOVA*					
naled	*See DIBROM*					
NOVA 40W	myclobutanil	f	40	3	asparagus	DWE
novaluron	*See RIMON*					
NOVODOR	*Bacillus thuringiensis*	i	18,000/g	4	potatoes, tomatoes	VBC
NUFOS 4E	chlorpyrifos	i	480 g/L	3	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, cucumber, garlic, onions (dry), pak choy, peppers, potatoes, radishes, rutabagas, sweet corn	CAU
OBERON	spiromesifen	i/m	240 g/L	3	cucurbits (vine crops), eggplant, leafy vegetables, peppers, sweet potatoes, tomatoes	BCZ
OPAL INSECTICIDAL SOAP	potassium salts of fatty acids	i	47	4	herbs	OMD
ORTHENE 75 SP	acephate	i	75	3	Brussels sprouts, cabbage, cauliflower, celery, lettuce (head), peppers, potatoes, sweet corn, tomatoes	ALS
oxamyl	*SEE VYDATE*					
PARASOL FLOWABLE	copper hydroxide	f	24.4	4	potatoes, tomatoes	NUA
PARASOL WG	copper hydroxide	f	50	3	beans, cucumbers, peppers, tomatoes	NUA
PARASOL WP	copper hydroxide	f	50	3	sugarbeets	NUA
PENNCOZEB 80WP	mancozeb	f	80	4	carrots, celery, cucurbits (vine crops), onions (dry), potatoes, sugarbeets, tomatoes	UPI

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permethrin	*See POUNCE, PERM-UP, AMBUSH*					
PERM-UP	permethrin	i	384 g/L	3	asparagus, beans, beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, carrots, Chinese broccoli, Chinese cabbage, horseradish, lettuce, onions, pak choy, peas, peppers, potatoes, radishes, sugarbeets, sweet corn, tomatoes	UPI
phorate	*See THIMET*					
phosmet	*See IMIDAN*					
POLYRAM DF	metiram	f	80	4	asparagus, carrots, celery, potatoes, sugarbeets, tomatoes	BAZ
PONCHO 600 FS	clothianadin	s	600 g/L	2	sweet corn	BCZ
potassium bicarbonate	*See MILSTOP*					
potassium salts of fatty acids	*See OPAL INSECTICIDAL SOAP, SAFER'S TROUNCE*					
POUNCE 384EC	permethrin	i	384 g/L	4	asparagus, beans, beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, carrots, Chinese broccoli, Chinese cabbage, horseradish, lettuce, onions, pak choy, peas, peppers, potatoes, radishes, sweet corn, tomatoes	UAG/ FMC
PRESIDIO	fluopicolide	f	39.5	2	brassica crops, cucurbits, lettuce, potatoes, rutabaga, tomatoes	VBC
PRESTOP	*Gliocladium catenulatum*		2 x 10^8 colony-forming units/g	3	greenhouse herb transplants (oregano, basil, parsley, thyme, dill)	PLG
PRISTINE WG	pyraclostrobin/ boscalid	f	12.8/ 25.2	2	brassica crops, carrots, celery, chives, garlic, onions, leeks, shallots, spinach	ENG
PRO-GRO	carbathiin/ thiram	s	30/ 50	4	onions	CRE
PROLINE 480 SC	prothioconazole	f	480 g/L	3	sugarbeets	BCZ
propamocarb/ chlorothalonil	*See TATTOO C*					
propiconazole	*See BUMPER, MISSION, TOPAS, TILT*					
prothioconazole	*See PROLINE*					
pyraclostrobin	*See CABRIO, HEADLINE*					
pyraclostrobin/boscalid	*See PRISTINE*					
PYRIFOS 15G	chlorpyrifos	i	15	4	broccoli, Brussels sprouts, cabbage, cauliflower, onions	UAG
pyrimethanil	*See SCALA*					

Use Codes: **a – acaricide** **b – bactericide** **f – fungicide** **h – herbicide** **i – insecticide** **m – miticide** **n – nematicide** **pgr – plant growth regulator** **r – rodenticide** **s – seed treatment** **v – vine killing**

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Class 2: Restricted – commercial use only; very hazardous and/or persistent

Class 3: Restricted – commercial use only; moderately hazardous and/or moderately persistent

Class 4: Restricted – commercial use only; low hazard and/or low persistence

[3] See page 139.

Table 4–1. Pesticides Used on Vegetable Crops in Ontario

Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
PYRINEX 480 EC	chlorpyrifos	i	480 g/L	3	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, Asian radish, cucumbers, garlic, onions (dry), peppers, potatoes, radish, rutabagas, sweet corn	UAG/ MAN
pyrmetrozine	*See FULFILL*					
QUADRIS FLOWABLE	azoxystrobin	f	250 g/L	3	asparagus, beets (table), carrots, horseradish, potatoes, radishes, rutabagas/turnips, spinach, sugarbeets, sweet corn, tomatoes	SYZ
quinoxyfen	*See QUINTEC*					
QUINTEC	quinoxyfen	f	250 g/L	3	melons, pumpkins, squash, lettuce	DWE
RANMAN 400SC	cyazofamid	f	34.5	4	carrots, cucurbits (vine crops), potatoes	ISK
REASON 500SC	fenamidone	f	500 g/L	3	brassica crops, onions, potatoes	BCZ
REVUS	mandipropamid	f	23.3	3	brassica crops, garlic, lettuce, leeks, onions, pepper (transplants), potatoes, spinach, tomatoes	SYZ
RIDOMIL GOLD 1G	metalaxyl	f	1	3	carrots, lettuce	SYZ
RIDOMIL GOLD 480SL	metalaxyl-M	f	480 g/L	3	snap beans, cucumbers, radish, spinach, potatoes	SYZ
RIDOMIL GOLD MZ 68WG	metalaxyl-M/ mancozeb	f	4/ 64	3	lettuce (head), onions, potatoes	SYZ
RIDOMIL GOLD + BRAVO twin pak	metalaxyl-M + chlorothalonil	f	480 + 500 g/L	3	potatoes	SYZ
RIMON 10 EC	novaluron	i	10	2	beans, brassica crops, peppers, potatoes	UAG
RIPCORD 400 EC	cypermethrin	i	407 g/L	3	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, lettuce, onions, potatoes, rutabagas, sweet corn, tomatoes	BAZ
ROOTSHIELD GRANULES	*Trichoderma harzianum*	f	1.0×10^7 colony-forming units/g	4	cucumbers, peppers, tomatoes	BWI
ROOTSHIELD HC	*Trichoderma harzianum*	f, s	1.0×10^7 colony-forming units/g	4	beans, lettuce, peas, peppers, tomatoes	BWI
ROVRAL	iprodione	f	500 g/kg	3	beans, cabbage, cauliflower, carrots (imported seed), garlic, leeks, lettuce, onions	BCZ
SAFER'S TROUNCE	potassium salts of fatty acids/ pyrethrins	i	20/ 0.2	4	herbs	SFR
SCALA SC	pyrimethanil	f	400 g/L	3	garlic, onions, potatoes, tomatoes	BCZ
SCHOLAR 50WP	fludioxonil	f	50	3	sweet potatoes	SYZ
SENATOR 70WP	thiophanate-methyl	f	70	4	sugarbeets	ENG
SENATOR PSPT	thiophanate-methyl	s	10	4	potatoes (seed piece)	ENG

Use Codes: **a – acaricide** **b – bactericide** **f – fungicide** **h – herbicide** **i – insecticide** **m – miticide** **n – nematicide** **pgr – plant growth regulator** **r – rodenticide** **s – seed treatment** **v – vine killing**

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Table 4–1. Pesticides Used on Vegetable Crops in Ontario

Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
SERENADE MAX	*Bacillus subtilis*	f	7.3 x 10^9 CFU/g	4	celery, garlic, lettuce, onions	UAG
SERENADE ASO	*Bacillus subtilis*	f	1 x 10^9 CFU/g	4	brassica crops, carrots, chives, cucurbit crops (vine crops), eggplant, garlic, onions, leafy vegetables, leeks, peppers, potatoes, radishes, rutabagas, spinach, sweet potatoes, tomatoes	UAG
SEVIN XLR	carbaryl	i	466 g/L	3	asparagus, beans, brassica crops, carrots, celery, cucurbits (vine crops), eggplant, lettuce, leafy greens, peppers, radishes, rutabagas, sweet corn, tomatoes	BCZ
SILENCER 120 EC	lambda-cyhalothrin	i	120 g/L	2	asparagus, beans, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, garlic, lettuce, onions, peas, potatoes, sweet corn, sweet potatoes, tomatoes	UAG/ MAN
SOLAN MZ POTATO ST FUNGICIDE	mancozeb	s	16	4	potato seed piece	NRA
SLUGGO PROFESSIONAL	ferric phosphate	i	0.76	4	beans, brassica crops, peas, rhubarb, sweet corn	ENG
spinetoram	*See DELEGATE*					
spinosad	*See ENTRUST, SUCCESS*					
spiromesifen	*See OBERON*					
spirotetramat	*See MOVENTO*					
Streptomyces lydicus	*See ACTINOVATE*					
STOROX	hydrogen peroxide	f	27	2	potatoes, sweet potatoes	BIB
SUCCESS 480 SC	spinosad	i	480 g/L	4	asparagus, beans (snap), brassica crops, celery, eggplant, endive, lettuce, leafy greens, parsley, green onions, leeks, chives, peppers, potatoes, radishes, rhubarb, rutabagas, spinach, Swiss chard, sweet corn, tomatoes	DWE
sulphur/sulfur	*See MICROSCOPIC SULPHUR, MICROTHIOL DISPERSS*					
SUPERIOR 70 OIL	mineral oil	a, i	99	4	rutabagas	UAG
SUPRA CAPTAN 80 WDG	captan	f	80	3	cucumbers, tomatoes, vegetable transplants in greenhouse (brassica crops, eggplant, peppers, tomatoes, celery)	UAG
SURROUND WP	kaolin clay	i	95	4	carrots, celery, cucurbits (vine crops), lettuce, parsley, potatoes	BAT
SWITCH 62.5 WG	cyprodinil/ fludioxonil	f	37.5/ 25	3	beans, cabbage, carrots, horseradish, mustard/ turnip greens, onions, parsnips, radishes, rutabagas	SYZ

Use Codes: **a – acaricide** **b – bactericide** **f – fungicide** **h – herbicide** **i – insecticide** **m – miticide** **n – nematicide** **pgr – plant growth regulator** **r – rodenticide** **s – seed treatment** **v – vine killing**

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Table 4–1. Pesticides Used on Vegetable Crops in Ontario

Examples of Brand Name/ Trade Name[1]	Active Ingredient/ Common Name	Use	Guaranteed % Active Unless Stated	Ontario Class[2]	Crop Registrations	Company or Agent's Code[3]
TANOS 50 DF	famoxadone/ cymoxanil	f	25/ 25	3	potatoes, tomatoes	DUQ
TATTOO C	propamocarb/ chlorothalonil	f	375 g/L/ 375 g/L	3	potatoes, cucurbits (vine crops)	BCZ
tefluthrin	*See FORCE*					
terbufos	*See COUNTER*					
thiamethoxam	*See ACTARA, CRUISER*					
THIMET 15-G	phorate	i	15	3	potatoes	AMV/ ENG
THIODAN 4EC	endosulfan	i	400 g/L	3	broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), eggplant, lettuce (head), peppers, potatoes, rutabagas, tomatoes	BCZ
THIODAN 50 WP	endosulfan	i	50	3	broccoli, Brussels sprouts, cabbage, cauliflower, celery, potatoes	BCZ
THIONEX 50 WP	endosulfan	i	50	3	broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), eggplant, lettuce (head), peppers, potatoes	UAG
THIONEX EC	endosulfan	i	400 g/L	3	tomatoes	UAG
thiophanate-methyl	*See SENATOR*					
thiram	*See THIRAM*					
THIRAM 75 WP	thiram	s	75	3	beans, beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, cucurbits (vine crops), eggplant, lettuce, mustard, onions, peas, peppers, radishes, spinach, sugarbeets, sweet corn, sweet potatoes, tomatoes	CRE
THURICIDE-HPC	*Bacillus thuringiensis*	i	4,000 IU/mg	4	brassica crops, celery, lettuce, spinach, tomatoes	VBC
TILT 250E	propiconazole	f	250 g/L	3	sweet corn	SYZ
TITAN ST	clothianidin	s	600 g/L	2	potatoes	BCZ
TOPAS 250E	propiconazole	f	250 g/L	3	asparagus, rutabagas	ENG
Trichoderma harzianum	*See ROOTSHIELD*					
TUBERSEAL	mancozeb	s	16	4	potato seed piece	NRA
UP-CYDE 2.5 EC	cypermethrin	i	250 g/L	3	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, lettuce, onions, potatoes, rutabagas, sweet corn, tomatoes	UPI
VITAFLO 280	carbathiin/ thiram	s	15.59/ 13.25	4	beans, peas	CRE
VYDATE L	oxamyl	i	240 g/L	2	potatoes	DUQ
zoxamide/mancozeb	*See GAVEL*					

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Table 4-2. Pest Control Product Companies

Code	Company/Agent	Website	Contact Number
****	Various manufacturers		
AFG	AEF Global Inc.	www.aefglobal.com	1-866-622-3222
AMV	AMVAC	www.amvac-chemical.com	323-264-3910
AVV/ALS	Arvesta Corp./Arysta LifeScience	www.arvesta.com, http://arysta-na.com	1-866-761-9397
BAT	Bartlett, N.M. Inc.	www.bartlett.ca	1-800-263-1287
BAZ	BASF Canada Inc.	www.agsolutions.ca, http://agro.basf.ca	1-877-371-2273
BCZ	Bayer Crop Science Inc.	www.bayercropscience.ca	1-888-283-6847
BIB	BioSafe Systems	www.biosafesystems.com	1-888-273-3088
BUL	Buckman Labs of Canada	www.buckman.com	405-424-4404
BWI	BioWorks Inc.	www.bioworksinc.com	585-924-4362
CAU	Cheminova Canada Inc.	www.cheminova.ca	519-472-0600
CRE	Chemtura Agrosolutions	www.chemtura.com	1-800-423-8569
DUQ	Dupont Canada Inc.	www.dupont.ca/ag	1-800-667-3925
DWE	Dow Agrosciences Canada Inc.	www.dowagro.com/ca	1-800-667-3852
ENG	Engage Agro Corp.	www.engageagro.com	1-866-613-3336
GOW	Gowan Company	www.gowanco.com	1-800-883-1844
HND	Hendrix and Dail	www.hendrixanddail.com	
ISK	ISK BioSciences	www.iskbc.com	440-357-4640
LLP	Loveland Products Canada Inc.	www.uap.ca	1-800-328-4676
MAN	MANA (Makhteshim Agan of North America) Canada Ltd.	www.manainc.ca	905-304-1168
NRA	Norac Concepts Inc.	www.noracconcepts.com	519-821-3633
NUA	NuFarm Agriculture Inc.	www.nufarm.ca	1-800-868-5444
OMD	Omex Agriculture Inc.	www.omexcanada.com	204-477-4052
PLG	Plant Products Co. Ltd.	www.plantprod.com	1-800-387-2449
SYZ	Syngenta Crop Protection	www.syngenta.com	1-877-964-3682
UAG	United Agri Products	www.uap.ca	1-800-265-4624
UPI	United Phosphorus Ltd.	www.uplonline.com	905-275-2525
VBC	Valent BioSciences Canada	www.valentbiosciences.com	1-800-682-5368
SFR	Woodstream Canada Corporation	www.woodstream.com	416-291-8150 1-800-800-1819

Table 4-3. Re-Entry Intervals for Pesticides Used on Vegetable Crops

Trade Name(s)	Active Ingredient	Re-Entry Interval	Crops
Actara	thiamethoxam	12 hr	celery, eggplant, lettuce, endive, parsley, leafy greens (see label),peppers, rhubarb, spinach, Swiss chard, potatoes, tomatoes
Actinovate SP	*Streptomyces lydicus*	1 hr	peppers, tomatoes
Admire 240F	imidacloprid	24 hr	brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, potatoes, sweet potatoes, tomatoes
Alias 240 EC	imidacloprid	24 hr	eggplant, lettuce, potatoes, sweet potatoes, tomatoes
Aliette WDG	fosetyl-al	12 hr	broccoli, bok choy, lettuce, onions, rutabagas
Allegro 500F	fluazinam	24 hr	beans, brassica crops, carrots, potatoes
Assail 70 WP	acetamiprid	12 hr brassica crops: 48 hr for scouting, 4 days for other activities	brassica crops, celery, lettuce, endive, parsley, spinach, Swiss chard, leafy greens (see label), peppers, potatoes, rhubarb, sweet corn, tomatoes
Beleaf 50SG	flonicamid	12 hr	beets (table), brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, endive, parsley, parsnips, peppers, potatoes, radishes, rhubarb, rutabagas, spinach, Swiss chard, sweet potatoes, tomatoes
Botanigard 22WP	*Beauveria bassiana*	4 hr	eggplant, peppers, tomatoes
Botran 75W	dicloran	12 hr	beans, garlic, lettuce
Bravo 500	chlorothalonil	48 hr	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, cucurbits (vine crops), onions, parsnips, potatoes, sweet corn, tomatoes
Cabrio EG	pyraclostrobin	12 hr (3 days for hand-thinning, pruning and harvest activities)	beets (table), carrots, cucurbits (vine crops), eggplant, garlic, horseradish, onions, peppers, radish, rutabaga, tomatoes
Cantus WDG	boscalid	12 hr	carrots, cucurbits (vine crops), eggplant, lettuce, onions, peppers, potatoes, tomatoes
Citation 75WP	cyromazine	12 hr	brassica leafy greens (see label), celery, lettuce, leafy greens (see label), parsley, spinach, Swiss chard
Concept	imidacloprid/ deltamethrin	24 hr brassica crops: 48 hr for irrigation, topping, tying, thinning and hand pruning	brassica crops, tomatoes
Copper 53W	copper sulfate	48 hr	beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), potatoes
Coppercide WP	copper hydroxide	greenhouse transplants: 24 hr	beans, cucumbers, peppers, potatoes, tomatoes (field and transplants)
Coragen	chlorantraniliprole	12 hr	beans, brassica crops, leafy vegetables (see label), cucurbits (vine crops), eggplant, lettuce, peas, peppers, potatoes, rhubarb, spinach, Swiss chard, sweet corn, sweet potatoes, tomatoes
Counter 15 G	terbufos	48 hr	sugarbeets
Curzate 60 DF	cymoxanil	24 hr	potatoes
Decree 50 WDG	fenhexamid	4 hr	tomato transplants (greenhouse)
Delegate WG	spinetoram	12 hr	asparagus, brassica crops, leafy vegetables, potatoes, radish, rhubarb, rutabagas, spinach, Swiss chard, tomatoes
Diazinon 500 E	diazinon	3 day	lettuce, onions, parsnips
Dibrom	naled	48 hr	beans (lima), broccoli, Brussels sprouts, cabbage, cauliflower, celery, lettuce, onions, peas, potatoes, spinach, sugarbeets, tomatoes

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Table 4–3. Re-Entry Intervals for Pesticides Used on Vegetable Crops

Trade Name(s)	Active Ingredient	Re-Entry Interval	Crops
Echo 720	chlorothalonil	48 hr	cucurbits (vine crops), onions, parsnips, sweet corn
Echo 90DF	chlorothalonil	48 hr	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, tomatoes
Entrust 80 W	spinosad	potatoes: 12 hr brassica crops: 72 hr for hand harvest or tying activities sweet corn: 7 days for hand harvest or detassling	asparagus, beans, brassica crops, celery, eggplant, lettuce, endive, leafy greens, parsley, green onions, leeks, chives, peppers, potatoes, radishes, rhubarb, rutabagas, turnips, spinach, Swiss chard, sweet corn, tomatoes
Folpan	folpet	24 hr	cucurbits (vine crops), tomatoes
Fulfill 50WG	pymetrozine	12 hr	potatoes
Gavel 75 DF	zoxamide/mancozeb	48 hr	potatoes
Grappie$_2$	imidicloprid	24 hr	cucurbits (vine crops), eggplant, lettuce, potatoes, sweet potatoes, tomatoes
Headline EC	pyraclostrobin	12 hr	beans, peas, potatoes, sugarbeets, sweet corn
Imidan 50 WP	phosmet	5 days (see label for details on re-entry interval)	carrots, celery
Inspire	difenoconazole	12 hr brassica crops: 72 hr for hand harvesting and irrigation, 24 hr for scouting	brassica crops, cucurbits (vine crops), eggplant, garlic, leek, onions, shallot, peppers, potatoes, sugarbeets, tomatoes
Kocide 2000	copper hydroxide	greenhouse transplants: 24 hr	beans, peppers (field and transplants), potatoes, tomatoes (field and transplants)
Lance WDG	boscalid	12 hr	beans (snap and lima), carrots, cucurbits (vine crops), eggplant, lettuce, onions, peas, peppers, potatoes, tomatoes
Lannate TNG	methomyl	12 hr broccoli, cabbage and cauliflower: 48 hr for hand pruning/harvesting lettuce: 24 hr for hand pruning/harvesting/thinning sweet corn: 18 days for hand detassling	beans, broccoli, Brussels sprouts, cabbage, cauliflower, lettuce, peas, sweet corn, tomatoes
Lorsban	chlorpyrifos	24 hr cauliflower: 10 days	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, cucumber, garlic, onions (dry), pak choy, peppers, potatoes, radishes, rutabagas, sugarbeets, sweet corn
Maestro 80DF	captan	48 hr	cucumber, tomatoes, vegetable transplants in greenhouse (crucifer, eggplant, pepper, tomatoes, celery)
Matador 120EC	lambda-cyhalothrin	24 hr green onion: 10 days for hand harvesting/thinning	asparagus, beans, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, garlic, leeks, lettuce, onions, peas, potatoes, sweet corn, sweet potatoes, tomatoes
Microscopic Sulphur	sulphur	24 hr	rutabagas
Microthiol Disperss	sulphur	24 hr	peas
MilStop	potassium bicarbonate	4 hr	cucurbits (vine crops), peppers
Movento 240 SC	spirotetramat	12 hr	brassica crops, celery, cucurbits (vine crops), eggplant, lettuce, endive, parsley, peppers, potatoes, rhubarb, spinach, Swiss chard, sweet potatoes, tomatoes

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Trade Name(s)	Active Ingredient	Re-Entry Interval	Crops
Nufos 4E	chlorpyrifos	24 hr cauliflower: 10 days	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, cucumber, garlic, onions (dry), pak choy, peppers, potatoes, radishes, rutabagas, sweet corn
Oberon	spiromesifen	12 hr	cucurbits (vine crops), eggplant, leafy vegetables, peppers, sweet potatoes, tomatoes
Orthene 75 SP	acephate	12 hr	Brussels sprouts, cabbage, cauliflower, tomatoes
		24 hr	celery , head lettuce[1], peppers, potatoes
		5 days	corn
Parasol	copper hydroxide	48 hr	beans, cucumbers, peppers, potatoes, sugarbeets, tomatoes
Penncozeb	mancozeb	24 hr	carrots, celery, cucurbits (vine crops), onions (dry), potatoes, sugarbeets, tomatoes
Perm-UP	permethrin	12 hr	asparagus, beans, beets (table), broccoli, Brussels sprouts, cabbage, cauliflower, carrots, Chinese broccoli, Chinese cabbage, horseradish, lettuce, onions, pak choy, peas, peppers, potatoes, radish, sugarbeets, sweet corn, tomatoes
Presidio	fluopicolide	12 hr brassica crops: 24 hr for hand pruning and irrigation	brassica crops, cucurbits, lettuce, potatoes, rutabaga, tomatoes
Prestop	*Gliocladium catenulatum*	4 hr	greenhouse herb transplants (oregano, basil, parsley, thyme, dill)
Pristine WG	pyraclostrobin/ boscalid	brassica crops: 4 days carrots, garlic, onion, leeks: 3 days for hand thinning/ harvesting celery, spinach: 24 hr, 9 days for hand thinning/harvesting	brassica crops, carrots, celery, chives, garlic, onions, leeks, shallots, spinach
Proline 480 SC	prothioconazole	24 hr	sugarbeets
Pyrifos 15G	chlorpyrifos	24 hr cauliflower: 10 days	broccoli, Brussels sprouts, cabbage, cauliflower, onions
Pyrinex 480 EC	chlorpyrifos	24 hr cauliflower: 10 days	broccoli, Brussels sprouts, cabbage, cauliflower, carrots, celery, Chinese broccoli, Chinese cabbage, Asian radish, cucumbers, garlic, onions (dry), peppers, potatoes, radish, rutabagas, sweet corn
Quintec	quinoxyfen	12 hr	melons, pumpkins, squash, lettuce
Ranman 400SC	cyazofamid	12 hr	carrots, cucurbits (vine crops), potatoes
Reason 500SC	fenamidone	brassica crops: 48 hr	brassica crops, onions, potatoes
Revus	mandipropamid	12 hr	brassica crops, garlic, lettuce, leeks, onions, pepper (transplants), potatoes, spinach, tomatoes
Ridomil Gold 1G	metalaxyl-M	12 hr	carrots, lettuce
Ridomil Gold 480SL	metalaxyl-M	12 hr	snap beans, cucumber, radish, spinach, potatoes
Ridomil Gold MZ 68WG	metalaxyl-M/ mancozeb	24 hr	lettuce (head), onions, potatoes
Rimon 10 EC	novaluron	12 hr	beans, brassica crops, peppers, potatoes
Rootshield Granules	*Trichoderma harzianum*	greenhouse transplants: 4 hr	cucumbers, peppers, tomatoes
Rovral	iprodione	12 hr	beans, cabbage, cauliflower, garlic, leeks, lettuce, onions

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Table 4–3. Re-Entry Intervals for Pesticides Used on Vegetable Crops

Trade Name(s)	Active Ingredient	Re-Entry Interval	Crops
Scala SC	pyrimethanil	12 hr bulb vegetables: 24 hr for hand thinning	garlic, onions, potatoes, tomatoes
Silencer 120 EC	lambda-cyhalothrin	24 hr	asparagus, beans, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, garlic, lettuce, onions, peas, potatoes, sweet corn, sweet potatoes, tomatoes
Success 480 SC	spinosad	potatoes: 12 hr brassica crops: 72 hr for hand harvest or tying activities sweet corn: 7 days for hand harvest or detassling	asparagus, beans (snap), brassica crops, celery, eggplant, endive, lettuce, leafy greens, parsley, green onions, leeks, chives, peppers, potatoes, radishes, rhubarb, rutabagas, spinach, Swiss chard, sweet corn, tomatoes
Superior 70 Oil	mineral oil	12 hr	rutabagas
Supra Captan 80 WDG	captan	48 hr	cucumbers, tomatoes, vegetable transplants in greenhouse (brassica crops, eggplant, peppers, tomatoes, celery)
Switch 62.5 WG	cyprodinil/fludioxinil	12 hr	beans, cabbage, carrots, horseradish, mustard/turnip greens, onions, parsnips, radishes, rutabagas
Tanos 50 DF	famoxadone/ cymoxanil	24 hr	potatoes, tomatoes
Tattoo C	propamocarb/ chlorothalonil	48 hr (4 hr for short-term tasks)	potatoes, cucurbits (vine crops)
Thiodan 4EC	endosulfan	4 days pumpkins, squash: 7 days potatoes: 5 days rutabagas: 2 days	broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), eggplant, lettuce (head), peppers, potatoes, rutabagas, tomatoes
Thiodan 50WP	endosulfan	brassica crops: 9 days celery: 4 days potatoes: 5 days	broccoli, Brussels sprouts, cabbage, cauliflower, celery, potatoes
Thionex 50 WP	endosulfan	4 days brassica crops, eggplant, peppers: 9 days potatoes: 5 days pumpkins, squash: 12 days	broccoli, Brussels sprouts, cabbage, cauliflower, celery, cucurbits (vine crops), eggplant, lettuce (head), peppers, potatoes
UP-Cyde 2.5 EC	cypermethrin	12 hr	asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, carrots, lettuce, onions, potatoes, rutabagas, sweet corn, tomatoes

[1] Workers must wear gloves in the field for 2-weeks following applications.

Table 4–4. Pesticides Used in Vegetable Crops That Affect Cholinesterase Levels in Blood

Product Name	Common Name(s)
acephate	Orthene 75 SP
carbaryl	Sevin XLR
chlorpyrifos	Lorsban 50 W, Pyrifos 15 G, Pyrifos 50 W, Pyrinex 480 EC, Nufos 4E, Lorsban 4E
diazinon	Diazinon 50 W, Diazinon 500 E, Agrox B-2, Agrox CD
dimethoate	Cygon 480, Lagon 480
malathion	Malathion 25 W, Malathion 85E
methamidophos	Monitor 480
methomyl	Lannate
naled	Dibrom
oxamyl	Vydate L
phosmet	Imidan 50 W
terbufos	Counter

5. Appendices

Appendix A. Ontario Ministry of Agriculture, Food and Rural Affairs Vegetable Crop Advisory Staff
A complete list of OMAFRA advisory staff is available on the OMAFRA website at www.ontario.ca/crops.

Specialty	Staff	Tel/Fax	E-mail
Application Technology Specialist	Jason Deveau	Tel 519-426-8934 Fax 519-428-1142	jason.deveau@ontario.ca
Crop Protection Program Lead	Denise Beaton	Tel 519-826-6594 Fax 519-826-4964	denise.beaton@ontario.ca
Entomologist – Horticulture Program Lead	Hannah Fraser	Tel 905-562-1674 Fax 905-562-5933	hannah.fraser@ontario.ca
IPM Systems Specialist	Margaret Appleby	Tel 613-475-5850 Fax 613-475-3835	margaret.appleby@ontario.ca
IPM Specialist, Specialty Crops	Melanie Filotas	Tel 519-426-4434 Fax 519-428-1142	melanie.filotas@ontario.ca
Minor Use Coordinator	Jim Chaput	Tel 519-826-3539 Fax 519-826-4964	jim.chaput@ontario.ca
New Crop Development Specialist	Evan Elford	Tel 519-426-4509 Fax 519-428-1143	evan.elford@ontario.ca
Nutrient Management Horticulture Crops Program Lead	Deanna Németh	Tel 905-562-1170 Fax 905-562-5933	deanna.nemeth@ontario.ca
Nutrition – Horticulture Program Lead	Christoph Kessel	Tel 519-824-4120, ext. 52480 Fax 519-824-5730	christoph.kessel@ontario.ca
Pathologist – Horticulture Program Lead	Michael Celetti	Tel 519-824-4120, ext. 58910 Fax 519-767-0755	michael.celetti@ontario.ca
Potato Specialist	Eugenia Banks	Tel 519-826-3678 Fax 519-826-4964	eugenia.banks@ontario.ca
Soil Management Specialist – Hort Crops	Anne Verhallen	Tel 519-674-1614 Fax 519-674-1564	anne.verhallen@ontario.ca
Vegetable Crops Specialist	Marion Paibomesai	Tel 519-826-4963 Fax 519-826-4964	marion.paibomesai@ontario.ca
Vegetable Crops Specialist	Janice LeBoeuf	Tel 519-674-1699 Fax 519-674-1564	janice.leboeuf@ontario.ca
Vegetable Crops Specialist	Elaine Roddy	Tel 519-674-1616 Fax 519-674-1564	elaine.roddy@ontario.ca
Weed Management Program Lead – Horticulture	Kristen Callow	Tel 519-674-1335 Fax 519-674-1564	kristen.callow@ontario.ca

Agricultural Information Contact Centre

Provides province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses.

1 Stone Rd. W.
Guelph, ON N1G 4Y2

Tel: 1-877-424-1300
Fax: 519-826-3442
E-mail: ag.info.omafra@ontario.ca

Appendix B: Ontario Ministry of Environment — Regional Contact Information

Region/County	Address	Telephone/fax
Central Region Toronto, Halton, Peel, York, Durham, Muskoka, Simcoe	5775 Yonge St., 8th Floor Toronto, ON M2M 4J1	Tel 416-326-6700 Toll-free 1-800-810-8048 Fax 416-325-6345
West-Central Region Haldimand, Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. W., 12th Floor Hamilton, ON L8P 4Y7	Tel 905-521-7640 Toll-free 1-800-668-4557 Fax 905-521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, Kawartha Lakes, Northumberland, Renfrew, Ottawa, Lanark, District of Nipissing (Twp. of South Algonquin)	1259 Gardiners Rd., Unit 3 PO Box 22032 Kingston, ON K7M 8S5	Tel 613-549-4000 Toll-free 1-800-267-0974 Fax 613-548-6908
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth	733 Exeter Rd. London, ON N6E 1L3	Tel 519-873-5000 Toll-free 1-800-265-7672 Fax 519-873-5020
Northern Region (East) Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma (East), Timiskaming, Sault Ste. Marie	199 Larch St., Ste. 1201 Sudbury, ON P3E 5P9	Tel 705-564-3237 Toll-free 1-800-890-8516 Fax 705-564-4180
Northern Region (West) Algoma (West), Cochrane, Kenora, Rainy River, Timmins, Thunder Bay	435 James St. S., Ste. 331 Thunder Bay, ON P7E 6S7	Tel 807-475-1205 Toll-free 1-800-875-7772 Fax 807-475-1745
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W. 7th Floor Toronto, ON M4V 1L5	Tel 416-327-5519 Fax 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave.W. 12A Floor Toronto, ON M4V 1L5	Tel 416-314-8001 Toll-free 1-800-461-6290 Fax 416-314-8452

Appendix C. Accredited Soil-Testing Laboratories in Ontario

The following labs are accredited to perform soil tests for pH, buffer pH, P, K, Mg and Nitrate-N on Ontario soils.

Laboratory Name	Address	Telephone/Fax/E-mail	Contact
A & L Canada Laboratories Inc. www.alcanada.com	2136 Jetstream Rd. London, ON N5V 3P5	Tel 519-457-2575 Fax 519-457-2664 E-mail aginfo@alcanada.com	Greg Patterson Ian McLachlin
SGS Agri-Food Laboratories www.agtest.com	503 Imperial Rd. Unit #1 Guelph, ON N1H 6T9	Tel 519-837-1600 1-800-265-7175 Fax 519-837-1242 E-mail lab@agtest.com	Jack Legg Papken Bedirian
Brookside Laboratories, Inc. www.blinc.com/	308 South Main St. New Knoxville, Ohio US 45871	Tel 419-753-2448 Fax 419-753-2949 E-mail jbrackman@blinc.com	Jackie Brackman Mark Flock
Exova Accutest Laboratory Exova Canada Inc. www.exova.ca	8-146 Colonnade Rd. Ottawa, ON K2E 7Y1	Tel 613-727-5692, ext. 317 Fax 613-727-5222 E-mail lorna.wilson@exova.com	Lorna Wilson
FoReST Laboratory http://lucas.lakeheadu.ca/forest/	955 Oliver Rd. BB1005D Thunder Bay, ON P7B 5E1	Tel 807-343-8639 Fax 807-343-8116 E-mail soilslab@lakeheadu.ca	Claire Riddell Joel Symonds
University of Guelph Laboratory Services www.labservices.uoguelph.ca/units/soil-nutrient/	University of Guelph P.O. Box 3650 95 Stone Rd. W. Guelph, ON N1H 8J7	Tel 519-767-6299 Fax 519-767-6240 E-mail aflinfo@uoguelph.ca	Nick Schrier
Stratford Agri Analysis www.stratfordagri.ca/	1131 Erie St. Box 760 Stratford, ON N5A 6W1	Tel 519-273-4411 1-800-323-9089 Fax 519-273-2163 E-mail: info@stratfordagri.ca	Keith Lemp Mark Aikman

There is no official accreditation in Ontario for tissue analysis, but all the accredited soil-testing labs are monitored for proficiency on tissue analyses.

Appendix D. Production Insurance

Production Insurance (PI) covers production losses and yield reductions caused by insured perils. This includes adverse weather, disease, wildlife and insect infestations. Depending on the plan, coverage is available on a total-yield, dollar-value or acreage-loss basis. Producers can choose the type and level of coverage that best meets their needs. When enrolled in PI, producers are guaranteed a level of production, based on their yield history and their chosen coverage level. Claims are paid when an insured peril causes a yield to fall below the guaranteed production.

In Ontario, Agricorp administers PI on behalf of the Government of Ontario and Agriculture and Agri-Food Canada. More than 16,000 producers and 2 million hectares (5 million acres) of Ontario farmland are insured each year.

Production Insurance is part of the suite of programs available under Growing Forward. In most plans, producers pay 40% of the total premium cost and none of the administration cost. Together, the federal and provincial governments contribute the other 60%. Administrative costs are fully funded by both levels of government.

PI is available to all Ontario farmers, landlords and sharecroppers who grow an eligible crop. Coverage is available on approximately 90 commercially grown crops in Ontario in the following sectors:

- forage
- fresh vegetables
- fruit
- grains and oilseeds
- processing vegetables
- specialty crops

For more information, please call Agricorp weekdays, 7 AM to 5 PM at 1-888-247-4999 or visit www.agricorp.com.

Agricorp
1 Stone Rd. W.
Box 3660, Stn. Central
Guelph, ON N1H 8M4

Tel: 1-888-247-4999
TTY: 1-877-275-1380
Fax: 519-826-4118
E-mail: contact@agricorp.com
www.agricorp.com

Ontario Crops Covered by Production Insurance		
Fruit Crops		
apples and apple trees	cherries (sweet, sour)	grapes and grape vines
peaches/nectarines	pears	plums
strawberries		
Vegetable Crops — Average Farm Yield or Total Production		
asparagus	peppers (banana, bell)	onions (seed, set, spanish, yellow)
broccoli	green beans and wax beans (processing)	butternut squash (processing)
cabbages	carrots (fresh)	carrots (processing)
cauliflower	celery	cucumbers (processing)
lettuce	lima beans (processing)	parsnips
peas (processing)	potatoes (fresh)	potatoes (processing)
red beets (processing)	rutabagas	tomatoes (processing)
sweet corn (fresh)	sweet corn (processing)	tomatoes (fresh)
Fresh Market Vegetables — Acreage Loss		
Root Vegetables (red beets, carrots, celeriac, French shallots, green onions, leeks, Spanish & yellow onions, parsnips, radishes, rutabagas, turnips, sweet potatoes, garlic)		
Leafy Vegetables (Brussels sprouts, broccoli, cauliflower, broccoflower, celery, Chinese cabbages, summer & winter cabbage, lettuce, mesclun, spinach, kale)		
Fruit Vegetables (cucumbers, eggplant, gherkins, melons, peppers, pumpkins, squash, tomatoes, watermelon, zucchinis)		
Other Vegetables (broad beans, green and wax beans, sweet corn, green peas)		
General Crops		
buckwheat	canola	coloured beans (black, cranberry, kidney, Japanese, other)
corn (grain, silage, organic options)	flax	forage
mustard	new forage seeding	peanuts
popping corn	rye	soybeans (tofu, natto and organic options available)
spring grain	seed corn	sorghum
spring wheat	sugar beets	sunflower
triticale	white beans	winter spelt, organic
winter wheat (soft white, hard white, soft red, hard red, organic options)		
Specialty Crops		
hemp, industrial	honey	tobacco (black, burley, flue cured)

Appendix E. Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES

http://www.agr.gc.ca/index_e.php

Eastern Cereals and Oilseeds Research Centre
960 Carling Ave.
Ottawa, K1A 0C6
Tel 613-759-1858

Greenhouse and Processing Crops Centre
2585 County Road 20
Harrow, N0R 1G0
Tel 519-738-2251

Southern Crop Protection and Food Research Centre
1391 Sandford St.
London, N5V 4T3
Tel 519-457-1470

Vineland Research Farm
4902 Victoria Ave. N.
Vineland, L0R 2E0
Tel 905-562-4113

Delhi Research Farm
Box 186 Schafer Rd.
Delhi, N4B 2W9
Tel 519-582-1950

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.inspection.gc.ca/english/toce.shtml

Belleville
345 College St. E.
Belleville, K8N 5S7
Tel 613-969-3333

Brantford
625 Park Rd. N., Ste. 6
Brantford, N3T 5P9
Tel 519-753-3478

Hamilton
709 Main St. W., Ste. 101
Hamilton, L8S 1A2
Tel 905-572-2201

London
19-100 Commissioners Rd. E.
London, N5Z 4R3
Tel 519-691-1300

St. Catharines
395 Ontario St., Box 19
St. Catharines, L2N 7N6
Tel 905-937-8232

Ottawa District
38 Auriga Dr., Unit 8
Ottawa K2E 8A5
Tel 613-274-7374, ext. 221

Toronto
1124 Finch Ave. W., Unit 2
Downsview, M3J 2E2
Tel 416-665-5055

UNIVERSITY OF GUELPH

Main Campus
Guelph, N1G 2W1
Tel 519-824-4120
www.uoguelph.ca

Alfred Campus
Alfred, K0B 1A0
Tel 613-679-2218
Fax 613-679-2423
www.alfredc.uoguelph.ca

Kemptville Campus
Kemptville, K0G 1J0
Tel 613-258-8336
Fax 613-258-8384
www.kemptvillec.uoguelph.ca

Ridgetown Campus
Ridgetown, N0P 2C0
Tel 519-674-1500
www.ridgetownc.on.ca

Department of Plant Agriculture
www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph
50 Stone Rd. W.
Guelph, N1G 2WI
Tel 519-824-4120, ext. 56083
Fax 519-763-8933

Department of Plant Agriculture, Simcoe
1283 Blueline Rd., Box 587
Simcoe, N3Y 4N5
Tel 519-426-7127
Fax 519-426-1225

Department of Plant Agriculture, Vineland
Box 7000, 4890 Victoria Ave. N.
Vineland Station, L0R 2E0
Tel 905-562-4141
Fax 905-562-3413

Lab Services Division
www.uoguelph.ca/labserv/
P.O. Box 3650, 95 Stone Rd. W.
Guelph, N1H 8J7
Tel 519-767-6299

Trace Organics and Pesticides
Tel 519-767-6485

Pest Diagnostic Clinic
Tel 519-767-6256

VINELAND RESEARCH AND INNOVATION CENTRE
4890 Victoria Ave. N.
Vineland Station, ON L0R 2E0
Tel 905-562-0320
Fax 905-562-0084
www.vinelandresearch.com

Appendix F: Diagnostic Services

Samples for disease diagnosis, insect or weed identification, nematode counts and Verticillium testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Rd. W.
Guelph Ontario, N1H 8J7

Tel	519-767-6299
Fax	519-767-6240
E-mail	aflinfo@uoguelph.ca
Website	www.guelphlabservices.com

Payment must accompany samples at the time of submission. Submission forms are available at www.guelphlabservices.com/AFL/submit_samples.aspx.

How to Sample for Nematodes

Soil

When to Sample

Soil and root samples can be taken at any time of the year that the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May and June and again in September and October.

How to Sample Soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm. If the soil is bare, remove the top 2 cm prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well. Then take a sample of 0.5–1 L from this. No one sample should represent more than 2.5 ha. Mix subsamples in a clean pail or plastic bag.

Sampling Pattern

If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of Subsamples

Based on the total area sampled:

500 m^2	10 subsamples
500 m^2–0.5 ha	25 subsamples
0.5 ha–2.5 ha	50 subsamples

Roots

From small plants, sample the entire root system plus adhering soil. For large plants, 10–20 g, dig fresh weight from the feeder root zone and submit.

Problem Areas

Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take samples from healthy areas in the same field. If possible, take both soil and root samples from problem and healthy areas in the same field.

Sample Handling

Soil Samples

Place in plastic bags as soon as possible after collecting.

Root Samples

Place in plastic bags and cover with moist soil from the sample area.

Storage

Store samples at 5°C–10°C and do not expose them to direct sunlight or extreme heat or cold (freezing). Only living nematodes can be counted. Accurate counts depend on proper handling of samples.

Submitting Plant for Disease Diagnosis or Identification

Sample Submission Forms

Forms can be obtained from your local Ontario Ministry of Agriculture, Food and Rural Affairs office. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. If symptoms are general, collect the sample from an area where they are of intermediate severity. Completely dead material is usually inadequate for diagnosis.

With plant specimens submitted for identification, include at least a 20–25-cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid drying out and contamination of the leaves by soil. Do NOT add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver to the Pest Diagnostic Clinic as soon as possible by first class mail or by courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting Samples

Place dead, hard-bodied insects in vials or boxes and cushion with tissues or cotton. Place soft-bodied insects and caterpillars in vials containing alcohol. Do not use water, as this results in rot. Do not tape insects to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the container.

UNIVERSITY of GUELPH
LABORATORY SERVICES

95 Stone Road West
Guelph, ON N1H 8J7
Tel: (519) 824-4120 ext. 57256
Fax: (519) 767-6240
Web: www.guelphlabservices.com

Sample Submission Form

LABORATORY USE ONLY: LS Form: SubP07/03/27 Pg. 1 of 1

Rec'd: By:_____ **Date Received:** _____

Delivered By: ☐ **Mail** ☐ **Courier** ☐ **In-Person**

LS Sample No: _____ **to** _____

Payment Rec'd: $_____ **Receipt #:**_____

Pest Diagnostic Clinic

Submitted By:			Owner (if different from submitter):		
Business Name (if applicable):			Business Name (if applicable):		
Street:			Street:		
City:	Prov:	Postal Code:	City:	Prov:	Postal Code:
Tel: ( ) -	Fax: ( ) -		Tel: ( ) -	Fax: ( ) -	
Email:			Email:		

Unless otherwise indicated, report and invoice will be sent to submitter

Report to: ☐ Submitter ☐ Owner Required Report Format: ☐ Fax ☐ E-Mail ☐ Mail

Invoice to: ☐ Submitter ☐ Owner Quotation #: _____ Purchase Order / U of G G/L code: _____

Services Required: ☐ Nematode Count ☐ Nematode Count from Roots ☐ SCN Cyst & Egg Count
☐ Plant Disease Diagnosis ☐ Insect Identification ☐ Plant Identification ☐ DNA Multiscan

If submitting a water sample, please answer the following question:

Is the purpose of the water test request to assess the quality of water for human consumption? ☐ **YES** ☐ **NO**

Date:_____ **Signature:**_____

Plant or Host Affected:		Cultivar/Variety:	Grower/Field sample #:
		Location of Plant (i.e. greenhouse, field, orchard, garden, etc.):	
Size of Planting:	% of Plants Affected:	Symptoms First Appeared in Past: ☐ Days ☐ Weeks ☐ Months ☐ Years	Degree of Injury: ☐ Severe ☐ Moderate ☐ Light
Cropping History:		Future Crop:	

Describe the problem in detail (i.e. symptoms, plant parts affected, distribution of symptoms):

Were chemicals applied? Please specify type of product(s) used and date(s) of application:

Additional comments and specific requests:

Appendix G. The Metric System

METRIC UNITS		
Linear Measures (length)		
10 millimetres (mm)	=	1 centimetre (cm)
100 centimetres (cm)	=	1 metre (m)
1,000 metres (m)	=	1 kilometre (km)
Square Measures (area)		
100 m x 100 m = 10,000 m^2	=	1 hectare (ha)
100 hectares	=	1 square kilometre (km^2)
Cubic Measures (volume)		
Dry Measure		
1,000 cubic millimetres (mm^3)	=	1 cubic centimetre (cm^3)
1,000,000 cubic centimetres (cm^3)	=	1 cubic metre (m^3)
Liquid Measure		
1,000 millilitres (mL)	=	1 litre (L)
100 litres (L)	=	1 hectolitre (hL)
Weight-Volume Equivalents (for water)		
(1.00 kg) 1,000 grams	=	1 litre (1.00 L)
(0.50 kg) 500 grams	=	500 millilitres (0.50 L)
(0.10 kg) 100 grams	=	100 millilitres (0.10 L)
(0.01 kg) 10 grams	=	10 millilitres (0.01 L)
(0.001 kg) 1 gram	=	1 millilitre (0.001 L)
Weight Measures		
1,000 milligrams (mg)	=	1 gram (g)
1,000 grams (g)	=	1 kilogram (kg)
1,000 kilograms (kg)	=	1 tonne (t)
1 milligram/kilogram	=	1 part per million (ppm)
Dry-Liquid Equivalents		
1 cubic centimetre (cm^3)	=	1 millilitre (mL)
1 cubic metre (m^3)	=	1,000 litres (L)

APPLICATION RATE CONVERSIONS		
Metric to Imperial or U.S. (approximate)		
litres per hectare x 0.09	=	Imp. gallons per acre
litres per hectare x 0.11	=	U.S. gallons per acre
litres per hectare x 0.36	=	Imp. quarts per acre
litres per hectare x 0.43	=	U.S. quarts per acre
litres per hectare x 0.71	=	Imp. pints per acre
litres per hectare x 0.86	=	U.S. pints per acre
millilitres per hectare x 0.014	=	U.S. fluid ounces per acre
grams per hectare x 0.014	=	ounces per acre
kilograms per hectare x 0.89	=	pounds per acre
tonnes per hectare x 0.45	=	tons per acre
Imperial or U.S. to Metric (approximate)		
Imp. gallons per acre x 11.23	=	litres per hectare (L/ha)
U.S. gallons per acre x 9.35	=	litres per hectare (L/ha)
Imp. quarts per acre x 2.8	=	litres per hectare (L/ha)
U.S. quarts per acre x 2.34	=	litres per hectare (L/ha)
Imp. pints per acre x 1.4	=	litres per hectare (L/ha)
U.S. pints per acre x 1.17	=	litres per hectare (L/ha)
Imp. fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
U.S. fluid ounces per acre x 73	=	millitres per hectare (mL/ha)
tons per acre x 2.24	=	tonnes per hectare (t/ha)
pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
pounds per acre x 0.45	=	kilograms per acre (kg/acre)
ounces per acre x 70	=	grams per hectare (g/ha)
Metric Conversions		
5 mL	=	1 tsp
15 mL	=	1 tbsp
28.5 mL	=	1 Imp. fl oz

DRY WEIGHT EQUIVALENTS		
Metric		**Imperial**
100 grams/hectare (g/ha)	=	1½ ounces/acre (oz/acre)
200 grams/hectare (g/ha)	=	3 ounces/acre (oz/acre)
300 grams/hectare (g/ha)	=	4¼ ounces/acre (oz/acre)
500 grams/hectare (g/ha)	=	7 ounces/acre (oz/acre)
700 grams/hectare (g/ha)	=	10 ounces/acre (oz/acre)
1.10 kilograms/hectare (kg/ha)	=	1 pound/acre (lb/acre)
1.50 kilograms/hectare (kg/ha)	=	1¼ pounds/acre (lb/acre)
2.00 kilograms/hectare (kg/ha)	=	1¾ pounds/acre (lb/acre)
2.50 kilograms/hectare (kg/ha)	=	2¼ pounds/acre (lb/acre)
3.25 kilograms/hectare (kg/ha)	=	3 pounds/acre (lb/acre)
4.00 kilograms/hectare (kg/ha)	=	3½ pounds/acre (lb/acre)
5.00 kilograms/hectare (kg/ha)	=	4½ pounds/acre (lb/acre)
6.00 kilograms/hectare (kg/ha)	=	5¼ pounds/acre (lb/acre)
7.50 kilograms/hectare (kg/ha)	=	6¾ pounds/acre (lb/acre)
9.00 kilograms/hectare (kg/ha)	=	8 pounds/acre (lb/acre)
11.00 kilograms/hectare (kg/ha)	=	10 pounds/acre (lb/acre)
13.00 kilograms/hectare (kg/ha)	=	11½ pounds/acre (lb/acre)
15.00 kilograms/hectare (kg/ha)	=	13½ pounds/acre (lb/acre)

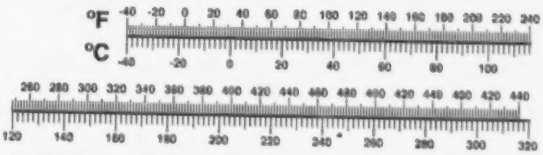
LIQUID EQUIVALENTS			
Litres/Hectare		**Approximate Gallons/Acre**	
		Imp. Gallons	US Gallons
50	=	4.45	5.35
100	=	8.90	10.70
150	=	13.35	16.05
200	=	17.80	21.40
250	=	22.25	26.75
300	=	26.70	32.10

Appendix G. The Metric System

CONVERSION TABLES — METRIC TO IMPERIAL

Length		
1 millimetre (mm)	=	0.04 inch (in.)
1 centimetre (cm)	=	0.40 inch (in.)
1 metre (m)	=	39.40 inches (in.)
1 metre (m)	=	3.28 feet (ft)
1 metre (m)	=	1.09 yards (yd)
1 kilometre (km)	=	0.62 mile (mi)
Area		
1 square centimetre (cm^2)	=	0.16 square inch (in^2)
1 square metre (m^2)	=	10.77 square feet (ft^2)
1 square metre (m^2)	=	1.20 square yards (yd^2)
1 square kilometre (km^2)	=	0.39 square mile (mi^2)
1 hectare (ha)	=	107,636 square feet (ft^2)
1 hectare (ha)	=	2.5 acres (acre)
Volume (dry)		
1 cubic centimetre (cm^3)	=	0.061 cubic inch ($in.^3$)
1 cubic metre (m^3)	=	1.31 cubic yards (yd^3)
1 cubic metre (m^3)	=	35.31 cubic feet (ft^3)
1,000 cubic metres (m^3)	=	0.81 acre-foot
1 hectolitre (hL)	=	2.8 bushels (bu)
Volume (liquid)		
1 millilitre (mL)	=	0.035 fluid ounce (Imp.)
1 litre (L)	=	1.76 pints (Imp.)
1 litre (L)	=	0.88 quart (Imp.)
1 litre (L)	=	0.22 Imp. gallons (gal)
1 litre (L)	=	0.26 US gallon (US gal)
Weight		
1 gram (g)	=	0.035 ounce (oz.)
1 kilogram (kg)	=	2.21 pounds (lb)
1 tonne (t)	=	1.10 short tons
1 tonne (t)	=	2,205 pounds (lb)
Pressure		
1 kilopascal (kPa)	=	0.15 pounds/square inch ($lb/in.^2$)
Speed		
1 metre per second (m/sec)	=	3.28 feet per second (ft/sec)
1 metre per second (m/sec)	=	2.24 miles per hour (mph)
1 kilometre per hour (km/h)	=	0.62 mile per hour (mph)
Temperature		
°F	=	(°C x 9/5) + 32

TEMPERATURE



For exact values the formula is:
Fahrenheit to Celsius: subtract 32 from number of °F, then multiply by 5/9.
Celsius to Fahrenheit multiply °C by 9/5 then add 32.

CONVERSION TABLES — IMPERIAL TO METRIC

Length		
1 inch (in.)	=	2.54 centimetres (cm)
1 foot (ft)	=	0.30 metre (m)
1 yard (yd)	=	0.91 metre (m)
1 mile (mi)	=	1.61 kilometre (km)
Area		
1 square foot (ft^2)	=	0.09 square metres (m^2)
1 square yard (yd^2)	=	0.84 metre (m^2)
1 acre	=	0.40 hectare (ha)
Volume (dry)		
1 cubic yard (yd^3)	=	0.76 cubic metre (m^3)
1 bushel (bu)	=	36.37 litres (L)
Volume (liquid)		
1 fluid ounce (Imp.)	=	28.41 millilitres (mL)
1 pint (Imp.)	=	0.57 litre (L)
1 gallon (Imp.)	=	4.55 litres (L)
1 gallon (U.S.)	=	3.79 litres (L)
Weight		
1 ounce (oz)	=	28.35 grams (g)
1 pound (lb)	=	453.6 grams (g)
1 ton	=	0.91 tonne (t)
Pressure		
1 pound per square inch (lb/in^2)	=	6.90 kilopascals (kPa)
Temperature		
°C	=	(°F–32) x 5/9

ABBREVIATIONS

%	= per cent (by weight)	km/h	= kilometres per hour
ai	= active ingredient	kPa	= kilopascal
AP	= agricultural powder	L	= litre
cm	= centimetre	m	= metre
cm^2	= square centimetre	m/sec	= metres per second
DG	= dispersible granular	m^2	= square metre
DP	= dispersible powder	mL	= millilitre
E	= emulsifiable	mm	= millimetre
e.g.	= for example	SC	= sprayable concentrate
EC	= emulsifiable concentrate	SP	= soluble powder
F	= flowable	t	= tonne
g	= gram	W	= wettable (powder)
Gr	= granules, granular	WDG	= water dispersible granular
ha	= hectare	WP	= wettable powder
kg	= kilogram	km/h	= kilometres per hour

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide, call the Ministry of the Environment at **1-800-268-6060.**

For pesticide poisonings and pesticide injuries, call the Poison Information Centre:

Toronto 1-800-268-9017
1-877-750-2233 (TTY)

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.** Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open; wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- **call the Poison Information Centre IMMEDIATELY.**

Emergency numbers are listed at the front of each Bell telephone directory.

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- by phone through the ServiceOntario Contact Centre, Monday to Friday, 8:30 AM to 5:00 PM ET
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  - 1-800-668-9938, toll-free across Canada
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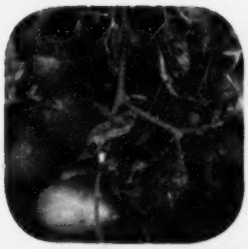

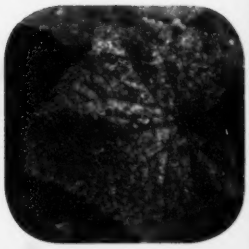

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